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The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

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VOL. XXXVIII WASHINGTON, D. C. OCTOBER 1954 No. 8

We lean on . . .

Tradition

Jeff McDermid

TRADITION is akin to history. Some folks venerate it and are often guided by it, and some don't care a whoop what's gone before. Fellows whose driving force is to do things differently and be original and who deny the value of precedent are generally known as nonconformists. They have their side of the case, too. To them, tradition is something to be broken with entirely and suddenly, as being unworthy of our new and brittle era, where change is always the point to strive for, ever free from reliance upon past usage, former customs, and old-fashioned ideals.

We go along with them insofar as tradition means lighting fire-crackers tied to a dog's tail on the Fourth, tipping over backhouses and busting windows on Halloween, telling shady stories in men's wash-rooms, voting a straight partisan ticket whoever runs, eating twice one's capacity on feast days, saving Saturday nights for a booze binge, playing bawdy monkey-shines with newlyweds, placing smoke bombs under an auto hood, and racing motors up quiet home streets.

As the British light opera gent said, "They never would be missed!" Likewise, I endorse the rebellion against customs of the dead past, like trying to live without a telephone, doing without running water and the indoor toilet, admiring enlarged crayon portraits of the family, relying upon patent medicines, keeping your own cow and chickens in the back yard, or feeding steam engine threshing crews.

It's all because we use the term "tradition" rather loosely. It's like "courage" and "sin." The words carry different meanings to different people.

What some men regard as courageous or sinful is like a picnic or a credit mark to others.

But the tradition to which I refer and by which I stand guard in my own honest right represents established standards and goals that caused our forebears (and ourselves when young) to launch and uphold a better sort of self-governing and self-adjusting enterprise in America. They often fell short of what was charted and hoped for and promised; and many of them died without reaching that objective which in their youth seemed so easy and sure to attain. But during these intervals tradition from the best of the past proved to be their guiding star and ever-present measure of true and lasting progress, decency, good will, and fair play.

IT'S those things we will eventually miss the most when we grow surfeited with pleasures and gadgets and novelties. In a way, it is almost part of our religion—this tradition. Much of it came to us in much the way that spirituality did, teaching reliance upon the substantial and pivotal elements that enter into our lives and experiences. Whenever I read some dignified and serious statement by some rough-and-ready chap from whom one seldom expects to hear sentimental expressions, I believe him to be in the grasp of homely tradition of a kind that is sealed into the cornerstone of our nation.

I'd like to introduce just such a thought or two by way of example. I first lift some quotes from the cowboy writer of range history and memoirs—Bob Beverly. Prose can be poetry if it is in tune with tradition. I can see all of America in what he says—not just the unbroken prairie and the lonely range rider.

"From my childhood on through manhood to old age, the only star that interests me to any extent has always been the North Star, for it brings back thoughts to me of things that happened most years of my life. Each night I go out of my camp to look at that one and only thing I have known in my life that remains as immovable today as it was back in my childhood.

"It was pointed out to me for the first time by my sainted mother as we sat around our little home yard on the banks of the Brazos river in the years of 1878 and 1879. As a child I asked how the cowboys found their way to the markets of the north. How were they able to find their way across the untraveled roads of those wide-open spaces of our plains section of Texas?

"Sometimes some rider of the trail would stop at our little camp and talk of his trip over the cattle trails to Kansas, and when I asked how he was able to find his way, he said: 'At night when we rode along we were guided by the North Star.'

"As a little boy this made a wonderful impression on me. As the years passed I learned to love one star only, the North Star. As I rode many lonesome trails at night, I learned to tell the time or nearly what it was by watching the big dipper's location at dusk as the stars came into sight; and estimating how long it would take the stars in the dipper to sink out of sight and come back on the other side of the North Star, with one of its line of stars always pointing to it.

"When the nights were cloudy and dark the old-time cowboy was lonesome, for he could not see the one and only thing that he figured was a permanent fixture in life, and which would remain the same to the end of life's trail. I cannot say that I ever worshipped that star, like it was the same as my Creator, but I came as near it, I guess, as any human being ever did. I figured that out behind that star was He who created such things to enable mankind to carry on this world.

"The North Star is now my only friend to remind me of Jeff Slator and Big Johnson, and Ab Blocker—the man who was said to have looked between the ears of his horse at more cattle on the trail than any living person. I like

to go out at night and gaze off into that far away range around the North Star, where I am sure all of them are there on open range and making hands where the Great Range Boss runs the general roundup wagons.

"If I only had a telephone line over there to converse with them as I look at the North Star, I would tell them that the old star has never varied since they left this range of ours; and ask them to be on the lookout for the rest of our old buddies, as we will be coming on soon to that range beyond the North Star. In my fancy I am riding

around while the herd is sleeping quietly out there on the bed ground, and my pony slows to a walk. I remove my hat and my thoughts turn backward as I ride over the flat again bound from old San Antonio with a herd headed for the Yellowstone."

To be guided by some celestial presence and be aware of the immutability and solemnity of this brief span we live is great comfort to men with the traditions held dear by Bob Beverly. Sometimes it is men of great simplicity and faith whose words sing like sweet music and give us the benefit of all homely and reassuring traditions that this age so sorely needs.

I HAVE repeatedly found that those who work close to earth and nature and who obey her signals and portents usually possess a great fund of mellow and hopeful traditions. In a crisis or in some severe test of courage and faith, the man who cares for the best of the past has more than an even chance of winning.

It has been said with some justice that the old-timers furnished the rich tradition but some of us late-comers supplied the enterprise and the ambition. I recently heard a successful farmer mention this in receiving an award earned by the place he cultivates because it is more than a century old and remains in the same family.

This speaker said that most of the credit for retaining and improving those century farms lies with the later two generations who tilled them and stocked them, more so at least than to the original homesteaders. The pioneers selected the site and experienced many great hardships, but the business acumen, hard work, and pride in family tradition evinced by the more recent owners made it possible for these farms to stay in the family and grow better each year.

He then went on to remark that of all the basic traditions and values which animated the establishment and enduring quality of such farmsteads, we must credit spirituality and reverence for religion and faith as the foremost asset.

Now I believe that by this he meant well-balanced, serene, and kindly spirituality. He surely never meant the brand of fanaticism and blue-nosed stiffness which too many of our pioneer groups exhibited in their family management. Theirs was the fear element instead of the love influence. I know one widely known natural scientist whose home life in boyhood was made miserable and cramped by a false religious attitude on the part of his crabby, over zealous father. At his earliest chance the boy ran away from the home place and never wanted to return for the human values it engendered—but he did come back to examine its soil and its flora and fauna.

So we decide between us here and now that traditions that reflect the right kind of reverence and faith—the kind that can forgive and be tolerant—are the living ones today. In this way we must ourselves be watchful, for we also

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Principles Involved in Soil Testing

By George E. Smith

Department of Soils, University of Missouri, Columbia, Missouri

FERTILIZATION practices on Midwest soils are rapidly changing. Less dependence is being placed on soil organic matter, legumes, and farm manures as the principal source of nitrogen—and other elements. In most areas there have been spectacular increases in the use of chemical fertilizing materials. It is just now being appreciated that legumes, when removed for hay, instead of greatly increasing soil fertility, add only limited amounts of nitrogen and mask fertility decline.

Legumes removed for hay (or soybeans for seed) contain more minerals than do comparable yields of grain crops when only the grain is harvested. Much dependence has been placed on the value of manure returned. Except in those areas where barn feeding is practiced, the efficiency of nutrient return in manures is much lower than commonly believed.

Early experimental work with fertilizers in the Midwest area was designed to determine the minimum quantity of nutrients to give a profitable yield increase. Many experiments have been conducted on placement of these small additions of fertilizer for maximum plant absorption. The response has been variable and significantly influenced by weather. In favorable seasons the high rate of nutrient release from soil organic matter has frequently masked the small amounts added in fertilizers. On unfertilized soil probably 95% of the nitrogen, and over 50% of the phosphorus, and some other elements absorbed by plants, come from the breakdown of soil organic matter.

In seasons unfavorable for the release of nutrients from soil humus, these small fertilizer additions may cause early stimulation and a starved plant before maturity. Under very dry conditions, these starter fertilizers may remain in the dry surface layers, while the active plant roots are in the low-fertility subsoil.

Recent experimental work in supplying crops with sufficient available plant nutrients, placed so they can be absorbed in unfavorable seasons to eliminate these elements as factors in production, has shown that initial differences in productiveness of many soils can be eliminated in favorable seasons.

The addition of plant nutrients in fertilizers to increase the capacity of low-fertility soils to produce top yields may in some cases nearly equal the value of the land. In the interest of economy and best plant growth (proper balance of nutrients is important), only those nutrients that are deficient should be added. No application of unneeded nutrients can be tolerated. Soil tests are being extensively used to determine elements that are in short supply.

First attempts to use soil tests to determine the kind of starter fertilizer to use were generally unsatisfactory. Early tests first developed for the low exchange capacity soils of the East and South gave poor correlations in the Midwest. However, recent developments and correlations in individual regions can show the nutrient reserves in individual soils and aid in the calculations of the quantities necessary to

Fig. 1. Soil tests show this soil is low in potassium. Where potash fertilizer was applied (left), the yield was more than doubled.

be added to remove these elements as limiting factors in crop growth. These tests are not perfect, but if good samples are properly analyzed, they can give information that will greatly aid in formulating an efficient fertilization program.

Fields Differ Widely

Soil surveys have been used to enumerate and classify readily visible soil differences. Soil fertility programs have been based on experiments conducted on individual soils. However, after years of different kinds of soil management, greater differences in productive capacity have developed within a soil classified as one type than those which existed as a general average in soils of widely different origin and properties. The differences in nutrient levels, according to soil tests of 20 individual plots on a formerly uniform single acre of land after 14 years of different experimental soil and crop management practices, are shown by the data given in Table I. In the dry season of 1953, the yields of crops on this experimental area varied widely. Corn yields varied from 26 to 87 bushels per acre; wheat from 8 to 40 bushels; barley from 19 to 70; soybeans from 15 to 35; and red clover from complete failure to 3 tons per acre. Soil tests are the only method available which can determine the nutrient reserves in soils so rapidly and can indicate fertility treatments for most efficient crop production.

TABLE I.—EFFECT OF SOIL MANAGEMENT ON NUTRIENT VARIATION IN PUTNAM SILT LOAM (14 YEARS CROPPING).

	Low	High
Phosphorus	8 lbs.	96 lbs.
Potassium	56 "	152 "
Magnesium	280 "	600 "
Calcium	2700 "	7280 "
pH	5.0	7.2
Lime requirement (H)*	6000 "	..... "
Organic matter	1.8%	2.4%

* Expressed as $CaCO_3$ equivalent.

Organic Matter, Key to Soil-testing Programs

The increased use of chemical nitrogen has been the major factor in the greater interest in soil testing and the heavier applications of other plant nutrients. Many Midwest soils supplied sufficient phosphorus, potassium, and other essential nutrients to meet crop requirements when yields were regulated by the limited amount of nitrogen supplied by organic matter in depleted soils. But when chemical nitrogen is added in optimum amounts, the removal of minerals by the crop is increased so much that the need for minerals by the crop is more apparent.

Soil organic matter has been the buffering agent that has compensated for improper soil management in the past. But with the significant loss of soil humus, and under the declining fertility, the need for rapid accurate methods of determining the nutrient status in soils has increased.

Soil organic matter contains about 5% nitrogen. Each per cent of the organic fraction then represents 20,000 pounds of organic matter, or 1,000 pounds of nitrogen in the surface 2,000,000 pounds of soil. Accordingly, a soil with 2.5% organic matter contains 2,500 pounds of nitrogen in this form. The rate of its breakdown is determined by the average climatic factors, under which for Missouri it has been found that from 1.50 to 3% of the total nitrogen in a silt loam will be released per year under corn and other cultivated summer crops. For clay soils and clay loams, the breakdown of organic matter will liberate from 1.25 to 2.50% of the soil nitrogen; and for sands and sandy loams, from 4.0 to 6.0% of the total become available. The amounts released under small grains are approximately one half of these quantities.

When considered in connection with adapted soil management factors, this method of calculation has given good correlations with crop responses to the calculated soil treatments. It is the

Fig. 2. All of this soil received the same fertilizer treatment. The area at left required lime. Soil tests are the best procedure for determining nutrient balances.

method which is being generally followed by many Missouri farmers. It is shown by an example in Table II as the method for calculating nitrogen fertilization practices for corn. The range in amounts of nitrogen expected to be released in a soil can be determined from the organic matter tests and the soil texture. For a silt loam containing 2.5% organic matter by test, this release could be from 37 to 75 pounds of nitrogen per acre. For each ton of legume residues turned under, the expected release is 30 pounds of nitrogen during the first year and 10 pounds the second year. It is assumed for this example that one ton of dry matter is plowed under. If carbonaceous residues of very low nitrogen content are added, then at least 20 to 30 pounds of additional nitrogen must be added per ton to satisfy the requirements of soil microorganisms in its decay. When manure of average composition is applied, Missouri experiments indicate that about four pounds of nitrogen will be released per ton the first season, and two pounds during the second year. It is assumed again for this example that six tons of manure are applied, which supply 24 pounds of active nitrogen. The total amount of nitrogen available, then, by calculation, would range from 91 pounds in very wet or dry seasons to 129 in favorable years. Since any nitrogen additions are by no means completely taken by the crop, a 100-bushel crop of corn requires about 2 pounds per bushel or 200 pounds per acre. Consequently, the amount of nitrogen that would need to be added, as given in this example, would vary from 71 to 109 pounds per acre. Since weather conditions cannot be foretold, the application of about 100 pounds of nitrogen per acre with adequate minerals would be the suggested application.

This method of calculation for the nitrogen, based on organic matter determinations of Missouri's 89 soil-testing laboratories, is being used by the agricultural workers. Good correlations are being obtained and many

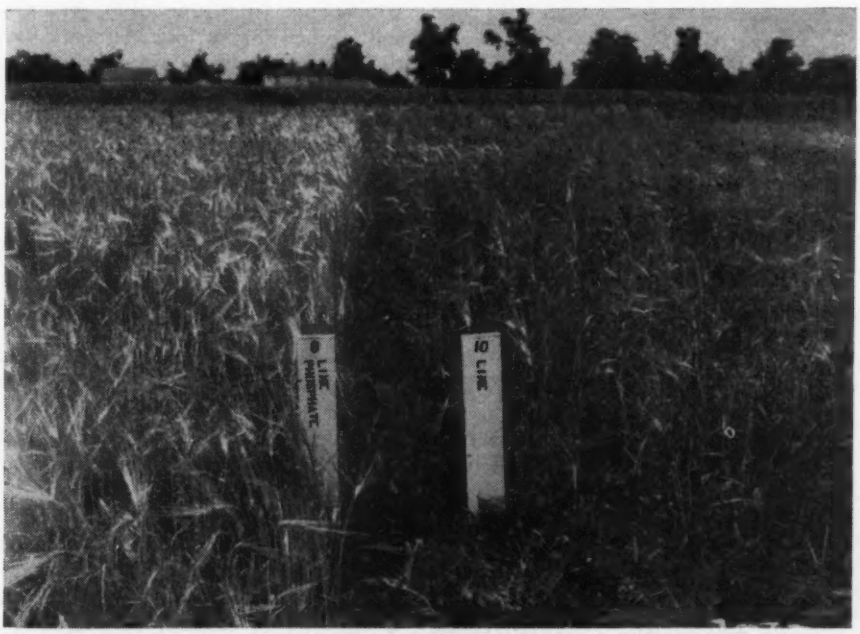

Fig. 3. According to soil tests, this soil was deficient in phosphorus. The application of superphosphate (left) increased yields of barley more than 30 bushels per acre.

farmers make their own calculations without the aid of technicians.

TABLE II.—EXAMPLE OF CALCULATIONS FOR ESTIMATING QUANTITY OF NITROGEN TO APPLY FOR YIELD OF 100 BUSHELS OF CORN ON A SILT LOAM WITH 2.50% ORGANIC MATTER.

Nitrogen released	Pounds per acre
From soil (1½–3%) (based on soil test)	37– 75
From legumes (1 ton)* (30 lbs. per ton first year, 15 lbs. second year)	30
N. required to decompose carbonaceous residues (straw, etc.) (30 lbs. N. per ton)	.....
N. released from manure (6 tons)** (4 lbs. per ton first year, 2 lbs. second year)	24
Total available	91–129
N. required for 100 bu. corn (2 lbs. per bu.)	200
N. to be added in fertilizer***	71–109

* Assuming 1 ton legume residues turned under.
** Assuming 6 tons average manure applied.
*** All mineral elements present in adequate amounts.

Soils Differ in Capacity to Hold Nutrients

Most soils in the Midwest region (except very sandy soil) have a high capacity to hold nutrients. Essential nutrients such as calcium, potassium, magnesium, and ammonia possess positive charges and are held by clay and organic matter (which have negative charges) in a manner somewhat similar to iron filings being held by a magnet. Available nutrients in the soil are not in true solution, but are held by varying forces that greatly reduce the rate of movement through the soil and loss through leaching. The amount of nutrients that a soil can hold is commonly referred to as exchange capacity. The term "exchange" is used because one ion can exchange for or replace another on the surface of the fine particles. They may also be exchanged by ions, usually hydrogen, given up by the plant root. For example, hydrogen can replace some of the calcium, magnesium, or potassium as a soil is leached. In turn, calcium replaces some of the hydrogen when a soil is limed.

Soils with high clay or organic matter content usually have a high exchange capacity. Soils which contain little clay or organic matter generally have a low exchange capacity. Most of the good soils of the Midwest have medium to high exchange capacities.

The kind of clay in a soil will influence the force with which these nutrients are held. Generally these elements are more strongly attracted by clays found in Midwest soils than those found in Southern states. Different species of plants have different capacities to absorb nutrients. For soil tests to give a reliable measure of nutrient reserves it is essential that the proper laboratory methods be used, and that results be correlated with field response.

The base exchange capacity of a soil is expressed in chemical terms of milliequivalents (m.e.) per 100 grams of soil. Since the various elements have different equivalent weights, a milliequivalent will vary for the various ions. For example, one m.e. per 100 grams of soil would be 20 pounds of hydrogen (1,000 pounds of limestone), 240 pounds of magnesium, 400 pounds of calcium, or 780 pounds of potassium per 2 million pounds of soil.

Exchange Capacity Influences Cation Availability

The addition of one element, particularly in excess quantities, will influence the availability to plants of other elements held in exchangeable form on the clay and organic matter. Frequently the application of one element in too large amounts will result in deficiency symptoms of other elements being observed in plants. An excess of potassium can reduce the availability of calcium or magnesium. An excess of ammonia has increased

TABLE III.—EXAMPLE OF CALCULATION OF EXCHANGE CAPACITY FROM SOIL TESTS.

Results of soil test		Milliequivalents of exch. ions per 100 grams of soil	Per cent saturation
O.M.	2.5	.....	....
P_2O_5	80 lbs./Acre	.....	....
K	195	195– 780= 0.25	1.4
Mg	480	480– 240= 2.00	11.6
Ca	4400	4400– 400=11.00	63.7
L.R. (H)	4000	4000–1000= 4.00	23.3
pH	5.8	.....	....
		Total 17.23	100.0

the absorption of manganese and iron by plants. It has been suggested that the detrimental effect of sodium in the less developed soils of the West may be traced to the effect on the activity of other absorbed ions. It is necessary for optimum plant growth that all elements be present in proper ratios.

It has been found that for optimum plant nutrient absorption under Missouri conditions the calcium should occupy from 70 to 80% of the exchange capacity of the absorption complex. Magnesium is considered in adequate supply when this element takes up 10% of that capacity. About 20 pounds of available potassium are required for each 1 m.e of exchange capacity (300 pounds per acre for a soil with a 15 m.e. exchange capacity). This is not necessarily the relationship for the additional potassium required when the exchange capacity is greater than 15 m.e. With higher exchange capacities it is less than 20 pounds for each additional m.e. exchangeable. Few soil manage-

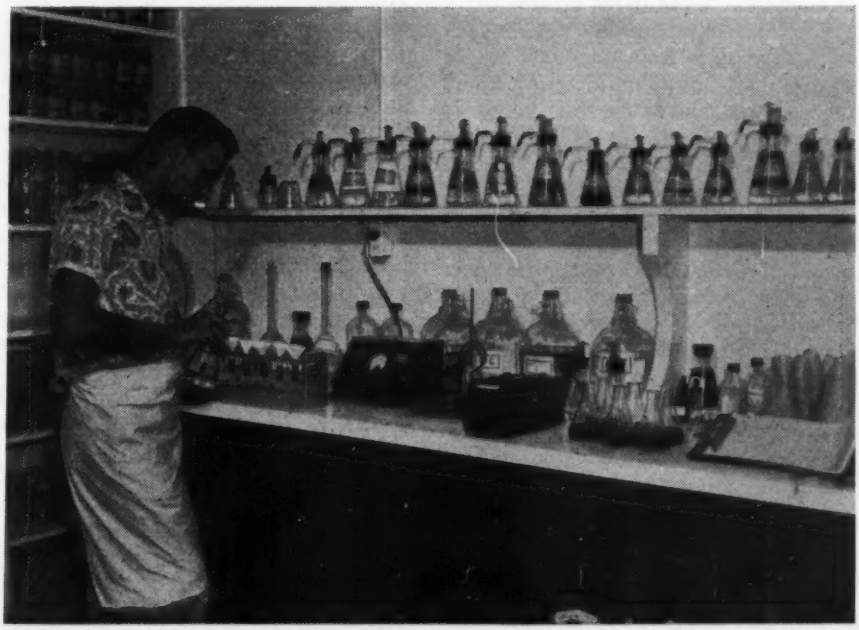

Fig. 4. Modern measuring equipment can increase speed and improve efficiency. Laboratory procedures are more accurate than are sampling procedures.

TABLE IV.—SUGGESTED NUTRIENT LEVELS FOR CALCIUM, MAGNESIUM, AND POTASSIUM IN MISSOURI SOILS (POUNDS PER ACRE). COMPILED BY E. R. GRAHAM.

Total cation exchange capacity*

	6	8	10	12	14	16	18	20	24	28	32
Ca.....	1800	2400	3000	3600	4200	4800	5400	6000	7200	8400	9600
Mg.....	144	192	240	288	336	384	432	480	576	672	768
K.....	234	250	266	280	296	312	351	390	468	546	624

* Expressed as milliequivalents per 100 grams.
1,000 lbs. of (40-mesh) pure calcium limestone will increase the calcium level 400 lbs.
1,000 lbs. of (40-mesh) pure dolomitic limestone will increase the calcium level 240 lbs., and the magnesium level 114 lbs.
100 lbs. of muriate of potash (60% K_2O) will increase the potassium level 50 lbs.

ment troubles have been encountered when enough hydrogen is present along with the nutrient cations to occupy from 10 to 20% of the exchange capacity.

Because of the influence of any single ion on the availability of others and wide differences in exchange capacities of Missouri soils, nutrient additions are being suggested on a basis of specific percentage saturation of the exchange capacity for each of them. Most of the Missouri county soil-testing laboratories are making their calculations of suggested applications on this basis.

The exchange capacity can be calculated as m.e. from the pounds per acre of these nutrients determined by the soil tests and totaled as shown by the example in Table III. For this calculation the pounds of each cation found per 2 million pounds of soil are divided by the above acre equivalents to give milliequivalents per 100 grams of soil. A total of these figures gives the total exchange capacity per 100 grams of soil. The percentage saturation of each element can then be calculated.

After the percentage saturation values are obtained, the amount that needs to be added to bring the values to 75% saturation for calcium, 10% for magnesium, and from 5 to 2.5% for potassium can be determined from Table IV. It is assumed that limestone passing a 40-mesh sieve will be available within a year and that additions should be on this basis. The calcium level will be increased 400 pounds per acre by the addition of 1,000 pounds of 40-mesh calcium limestone, or by 240 pounds of calcium, plus 114 pounds of magnesium by the same quantity of 40-mesh dolomite (45.72% $MgCO_3$).

Determining the "Lime Requirement"

There is a close relation between the pH of the soil, the calcium level, and the lime requirement. The pH value of a soil reflects the balance of general mineral cations in total against the hydrogen cation on the exchange complex of the soil. However, when soils differ widely in nature of colloidal material, the pH measurements are of limited value in determining the lime status. Soils with widely different needs for calcium, or lime, may have the same pH. A determination for pH can furnish information on soils of low exchange capacity that have been limed, since the pH level will rise rapidly after liming. On soils of high clay or organic matter content, large applications of limestone can be made with only a small change in pH. Changes in exchangeable hydrogen, as shown by lime requirement tests, are reflected slowly after liming.

The lime requirement test, developed by Woodruff, actually represents the amount of fine, pure calcium carbonate that would be required to replace the exchangeable hydrogen of the soil. Since most limestones are not 100%

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Peas for Canning or Freezing in New York State

By M. T. Vittum and A. R. Hamson

New York Agricultural Experiment Station, Geneva, New York

GREEN peas are an important part of our national diet, as is evidenced by the fact that for the last 10 years farmers in the United States have devoted slightly over 460,000 acres per year to this crop. Major production is centered in Wisconsin, Washington, Oregon, and Minnesota. These States have averaged 140, 59, 55, and 49 thousand acres of peas annually, respectively, over the 10-year period; while New York ranks fifth with a 10-year average of 33 thousand acres.

The relative pea acreage in New York State when compared with the United States as a whole has been decreasing. Before 1939-1943, for example, the acreage in New York State always exceeded 10 per cent of the United States acreage. During the five years 1939-1943, the proportion was exactly 10 per cent; while in the years since this period, New York acreage has been decreasing quite rapidly while the United States average has tended to increase.

Along with the relative decrease in acreage in New York State, it is interesting to note that since the period 1920-1924, average yields per acre within New York State have always been less than the average yields for the United States as a whole. During the 10 years from 1941 to 1950, Utah, Washington, and Oregon led in average yields with 2,880, 2,400, and 2,220 pounds of shelled peas per acre, respectively. These high average yields are obtained for growing well-adapted varieties in fertile mountain valleys or in other areas of relatively high elevation having cool growing seasons, and often with supplemental irrigation.

When the data are combined to give total pea production in thousands of tons of shelled peas, it is very evident that New York is rapidly falling behind when compared with the United States as a whole. Up until 1933, New York produced more than 10 per cent of the nation's peas; from 1933 to 1940, the State produced almost exactly 10 per cent of the United States total; while in the years since 1940, production has dropped to an average of less than 5 per cent of the United States total for the 5-year period centered in 1951. It thus becomes evident that efforts must

Fig. 1. Peas are normally planted with conventional grain drill equipment. ***(Photo by Robert Wesselmann)***

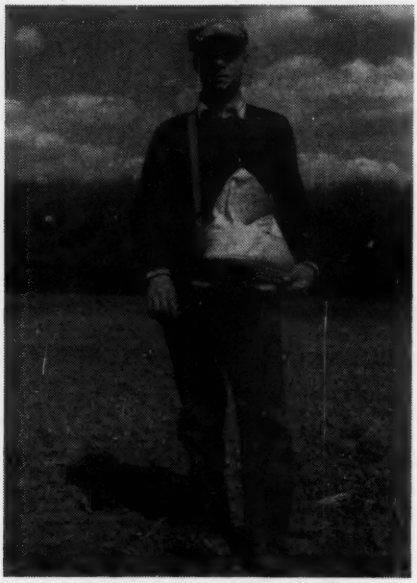

Fig. 2. Seeding alfalfa immediately after planting the peas. ***(Photo by Robert Wesselmann)***

be concentrated on methods of improving the average yield of New York peas in order that the pea industry will not be eliminated from this State.

The above summary makes the future of the pea industry in New York (and other Eastern pea-producing areas) appear dim; yet the problem can be solved. If New York pea growers could average 3,000 pounds of fancy peas per acre each year, acreage in the State would rapidly return to, and would probably exceed, its former maximum of 39,000 for the five-year period, 1938-1942. Peas fit well into New York rotations, either as a nurse crop for new seedings of clover and alfalfa or as a crop preceding wheat which, in turn, is seeded with legumes. Thus the crop is directly competitive with spring-planted small grain, yet most growers would prefer the cash returns from a 3,000- or 4,000-pound crop of fancy peas to the returns, either cash or feed, normally obtained from oats or spring barley.

Why isn't the average yield at least 3,000 pounds per acre? Because somewhere along the line, growers have failed to follow one or more of the following practices which, as proved by experience and research, are essential for obtaining maximum yields in this and other states.

1. ***Well-drained soil:*** Peas grow best in cool weather and when adequate, though not excessive, amounts of soil moisture are available. In order to plant early in the season so that the

Fig. 3. Cultipacking the pea and alfalfa seed presses soil around the seed to insure uniform germination. ***(Photo by Robert Wesselmann)***

Fig. 4. Close-up of pea field infested with wild mustard plants. ***(Photo by Robert Wesselmann)***

peas can take advantage of the cooler temperatures which predominate at that time, the soil must be well drained. Peas are very sensitive to poor soil aeration which is caused by poor drainage. Survey data obtained in 1945 and 1953 (Table I) indicate a very definite correlation between soil drainage and the acre yield of peas. In both years, peas grown on well-drained soil produced at least twice as much per acre as those grown on poorly drained soil.

TABLE I.—EFFECT OF SOIL DRAINAGE ON PEA YIELDS

Drainage	Pounds of peas per acre	
	1945 (71 fields)	1953 (323 fields)
Excellent	.....	3,060
Good.....	2,420	2,510
Fair.....	1,290	2,010
Poor.....	780	1,350

2. ***Lime, if necessary:*** Like most other vegetable crops, peas are sensitive to soil acidity, and a pH of at least 5.5 is desirable for the production of this crop (Table II). A pH of 6.5 would be ideal, so a grower should apply lime on acid soils before attempting to grow peas. As mentioned previously, peas are often used as a nurse crop for new seedings of clover or alfalfa and inasmuch as these small-seeded legumes are also very sensitive to soil acidity, the liming is of considerable benefit for the clover or alfalfa as well as for the peas. In rotations which include both potatoes and peas, growers can drill 500 pounds of ground limestone (preferably dolomitic) in contact with the seed. This amount of lime will not materially change the pH so that potato scab will not be enhanced, yet it will enable the peas to produce a good crop even though the soil is quite acid.

TABLE II.—EFFECT OF SOIL ACIDITY AND FERTILITY LEVEL ON PEA YIELDS. 1945 SURVEY.

pH	Pounds of peas per acre	
	P less than 8 K less than 75	P more than 8 K more than 75
Less than 5.5	1490	2080
5.5 to 7.5....	2560	2690

Fig. 5. Area adjacent to that shown in Fig. 4, but treated with dinitro compound for weed control. ***(Photo by Robert Wesselmann)***

3. ***Fertilize liberally:*** Peas respond to liberal amounts of complete fertilizer. Peas which have been well fertilized tend to remain in a fancy condition longer than those which have been inadequately fertilized. The slower rate of maturity of well-fertilized peas results primarily from a larger set of later pods which increases the ratio of younger and more tender or immature peas in the composite sample.

Data summarized in Table II were obtained from a detailed survey conducted in 1945. It is evident from the data in this Table that in soils where the pH was less than 5.5, the response to higher levels of phosphorus and potash was almost 600 pounds per acre. In soils where the acidity was not as

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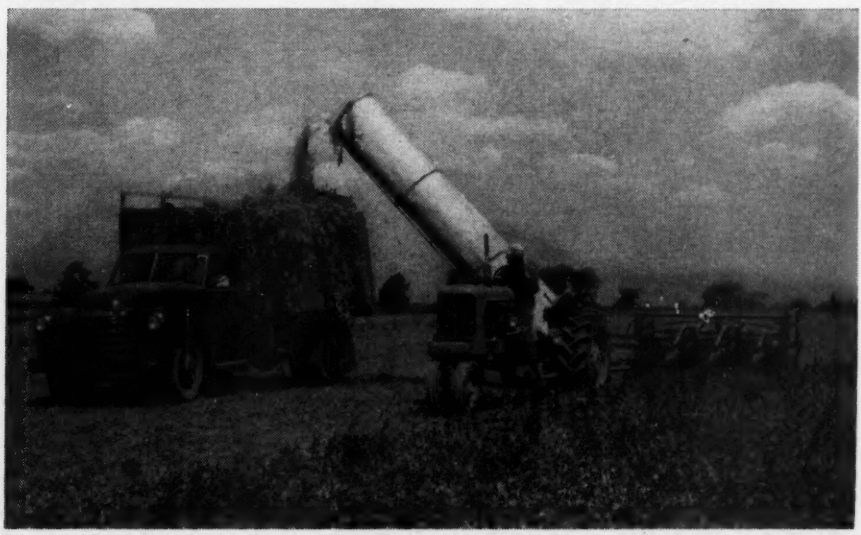

Fig. 6. Modern machinery has greatly reduced the labor required to harvest an acre of peas. ***(Photo by Robert Wesselmann)***

Relation of Fertilizer to Quality and Yield of Flue-cured Tobacco

By J. M. Elliot, Soil Specialist, and
L. S. Vickery, Officer-in-charge

Dominion Experimental Substation, Delhi, Ontario

THE effect of climate and soil has confined production of flue-cured tobacco in Ontario to more or less clearly defined geographic areas bordering Lake Erie and Lake Ontario. Many types of soils are found within these areas, but only a few will produce good quality leaf. These flue-cured tobacco soils range from sands to sandy loams in texture, are low in organic matter, and have a low inherent chemical fertility. Approximately 115,000 acres of these Ontario soils were planted to flue-cured tobacco in 1954.

Studies on the plant-nutrient requirements of flue-cured tobacco on Fox sand in relation to yield and quality have been conducted since the Delhi Substation was opened in 1933. Investigations of the chemical composition of the cured leaf in relation to soil fertility have been under study the last few years.

A balanced supply of nutrients is necessary to produce high yields of good quality tobacco. A slight deficiency of nitrogen during the last few weeks of growth will usually improve quality and maturity. An over-supply of certain nutrients may increase the yield but lower the quality. Profits depend on quality as well as yield.

Table I reveals the quantity of nutrients per acre removed from the field in a 1,500-pound crop of good quality leaf and what is supplied in the fertilizer and the nutrient content of stalks and roots left in the field. (1,4). Although only 20 pounds of nitrogen per acre are being added directly in the form of fertilizer, 32 pounds of nitrogen are removed by the leaf. The additional nitrogen is supplied by the organic matter and indirect fertilization of tobacco through the use of nitrogenous fertilizers on the rye the summer before tobacco or by a manure application. At present, approximately 10 times more phosphorus is being applied than is absorbed by the plant and 17 times the quantity removed by the

Fig. 1. Flue-cured tobacco showing severe potash starvation. A fertilizer high in potash is necessary for producing good quality leaf.

TABLE I.—APPROXIMATE NUTRIENT UPTAKE OF FLUE-CURED TOBACCO AND ADDITIONS IN FERTILIZER—1,500 POUNDS OF LEAF

Nutrient	Leaf content lbs.	Stalks & roots lbs.	Total crop lbs.	Amt. supplied in 1,000 lbs. 2–12–10
Nitrogen (N)	32	18	50	20
Phosphorus (P_2O_5)	7	5	12	120
Potassium (K_2O)	47	53	100	100
Magnesium (MgO)	16	10	26	20
Chlorine	18	17	35	20

leaf. Of course, a considerable amount of phosphorus becomes unavailable to the plant through "fixation." The amount of potash supplied by 1,000 pounds of a 2-12-10 mixture equals the need of the total crop, but over one half will be returned to the soil through roots and stalks. Each ton of tobacco fertilizer contains 200 pounds of dolomitic limestone. The chlorine content of the tobacco fertilizer, according to the Advisory Fertilizer Board for Ontario, should not be over 2%, thus part of the potash is necessarily supplied from sulphate of potash.

Investigation Procedure

Various fertilizer studies are being conducted on Fox sand at the Delhi Substation, some of which are reported in this paper. All fertilizer experiments are conducted on quadruplicate 1/40-acre plots arranged in randomized blocks. Treatments are applied with a combination planter using a metering fertilizer device (3). A 2-year rotation with tobacco alternating with fall rye is used in all fertilizer experiments presented in this paper. The flue-cured variety Delcrest is grown. The cured leaf is sorted by experienced tobacco graders into 19 commercial grades and a numerical expression of its market value is obtained by assigning to each grade the price for that grade as determined from the average farm price for that year. Chemical analyses are conducted on the lamina of the cured leaf

Fig. 2. Magnesium deficiency or "sand drown" can be serious in Ontario flue-cured tobacco soils if an insufficient amount of magnesium is added in the fertilizer mixture.

Fig. 3. Transplanting tobacco at the Delhi Substation, using a metering fertilizer attachment for applying accurate amounts of nutrients.

and reported on an oven-dried basis. The average farm price per pound in 1951, 1952, and 1953 was 44.6, 42.3, and 43.8 cents respectively.

Soil Characteristics

The surface soil of the Fox sand at the Delhi Substation consists of 85% sand, 7.5% silt, and 7.5% clay. It is moderately acid (pH 5.8 to 6.2), fairly low in organic matter (1.0 to 1.2%) and total nitrogen (0.05%), and has low base exchange (5.0 m.e./100 gm. of soil). The replaceable potassium is about 160 pounds per acre, while the exchange forms of calcium and magnesium are found to be about 800 and 100 pounds per acre respectively. The acid-soluble phosphorus test shows about 40 pounds of P_2O_5 per acre.

Responses from Nitrogen

The effect of three rates of nitrogen on the agronomic indices is shown for 1952-1953 in Table II. Data indicate the advisability of controlling nitrogen within narrow limits, as 30 pounds of nitrogen significantly lowered the quality and returns, and impaired the maturity without significantly increasing the yield over the 10-pound treatment. Excessive nitrogen tends to produce thin lugs that will waste under drought conditions or become lifeless during curing, and coarse, thin upper leaves of poor texture and colour. Insufficient nitrogen will produce a short, papery leaf.

TABLE II.—THE EFFECT OF NITROGEN ON THE VARIOUS INDICES 1952-1953 (2-YEAR AVERAGE)

Nitrogen lbs./acre*	Grade index (¢)	Yield /Acre (lbs.)	Returns /acre ($)	Maturity index **
10	47.8	1,807	863	62.4
20	43.4	1,821	791	60.0
30	40.8	1,840	751	59.0
L.S.D. (.05)	3.0	N.S.	96	2.4
(.01)	4.4	N.S.	N.S.	N.S.

* With 120 lbs. P_2O_5 and 100 lbs. K_2O per acre.
** High figures indicate earlier maturity.

Responses from Phosphorus

Various levels of phosphoric acid were compared with a constant level of nitrogen and potash over a 3-year period. Table III shows no significant difference among treatments for any of the indices. These results indicate

TABLE III.—THE EFFECT OF PHOSPHORUS ON THE VARIOUS CROP INDICES 1951-1953 (3-YEAR AVERAGE)

Phosphoric acid lbs./acre*	Grade index (¢)	Yield /acre (lbs.)	Returns /acre ($)	Maturity index
0	45.6	2,024	922	60.0
60	46.8	2,038	953	60.3
120	44.3	1,993	883	60.0
180	45.0	1,999	900	60.2
L.S.D. (.05)	N.S.	N.S.	N.S.	N.S.

* With 20 lbs. N. and 120 lbs. K_2O per acre.

that on Fox sand cropped with tobacco there is a residual phosphorus effect due to the heavy applications in the past. As only 12 pounds of P_2O_5 per acre are required for a tobacco crop, possibly the application of phosphorus may be reduced on some soils since over 120 pounds of P_2O_5 per acre are applied on tobacco farms. On some heavier tobacco soils, growers are broadcasting an additional 30 to 40 pounds of P_2O_5 prior to transplanting and are hastening maturity without any apparent detrimental effect. The need for phosphorus is greater on soils with considerable colloidal material and on farms that have recently been put into tobacco production.

Responses from Potash

Significant differences in Table IV show among potash treatments for price, yield, returns, and maturity. High amounts of potash must be applied to produce high quality tobacco, but an over-supply may tend to lower quality and delay maturity. The 100- and 140-pound rates gave optimum quality, while the 180-pound rate significantly delayed maturity but gave the highest returns and yield. Results indicate that it is necessary to apply at least 100 pounds of potash on land that has had high rates of potash applied in the past, which was the case in this experiment. Although significant differences did not show among treatments for the potassium content of the cured leaf, the leaf from the low rates of potash appear to have lower amounts of potassium than where larger amounts of potash were applied.

All tobacco soils in the district appear to respond to potash fertilization, although soil analyses indicate these soils to be medium in available potash.

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Fig. 4. Rye-tobacco rotation is widely practiced in Ontario. The rye prevents erosion, adds organic matter, and helps to hold soil moisture and nutrients.

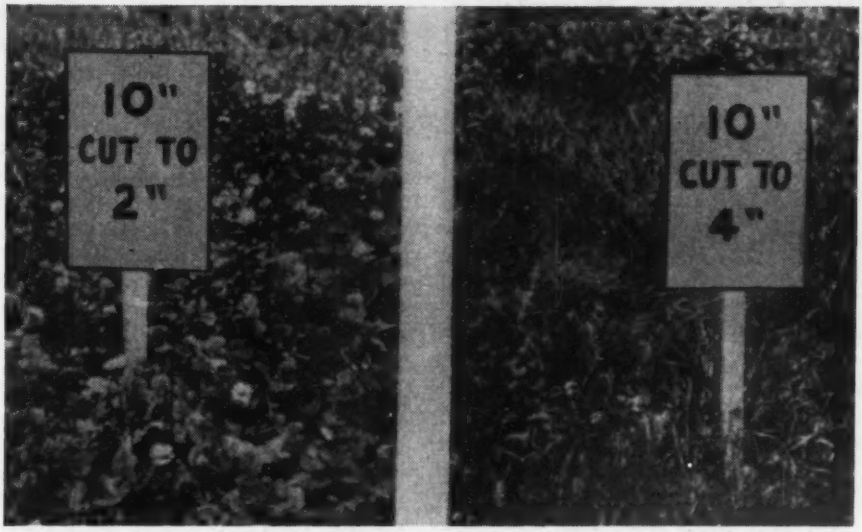

Fig. 1. The effects of management on the prevalence of ladino. Left: Cut when 10 inches to 2 inches is mostly ladino. Right: Cut when 10 inches to 4 inches is mostly grass.

Longer Life for Ladino

By B. A. Brown

Department of Plant Science, University of Connecticut, Storrs, Connecticut

IT is now 25 years—one fourth of a century or the span of a generation—since ladino clover came from near our Western Shores to the East Coast. Not many years after the arrival of the first ladino seed in the Northeast the crop had established a reputation for unexcelled pasturage and for being a valuable legume to have in triple-purpose (pasture, silage, and hay) stands of perennial forages. In Connecticut its importance and popularity may be pictured from the fact that in 1948 ladino had been seeded on 55% of the area managed by our 24 best pasture-minded farmers. And for six years ladino has been the luxuriant, green carpet on which the champions in New England's pasture contests have trod to fame.

For nearly a score of years ladino has been migrating both southward and westward. From incomplete information, I would venture the guess that it is now grown in most of the states and over much of Canada. Perhaps no forage crop has ever spread so far in so short a time.

Before any uninformed readers assume ladino, is, indeed, a plant with miraculous characteristics, I should state that it has weaknesses, disadvantages, and quite rigid requirements. (But what Princess has not?) Rumors and authentic reports lead me to conclude that the span of life of numerous ladino seedings is rather short—much shorter than it should or could be.

In much of the Northeast, at least, such early passing of this perennial

Fig. 2. Five-year-old ladino-orchard grass which received 1,200 lbs. of 60% muriate of potash before seeding and none thereafter. Most of the ladino starved from the stand.

clover from our grasslands is one of the prime agricultural tragedies. Tilling and reseeding our sloping lands not only take time, seed, and much mechanical power, but what is most important, they also expose the already shallow topsoil to the eroding forces of wind and water.

Old Stands Can Be Productive

Many will argue that to obtain the maximum benefits from ladino or other legumes, they should be rotated with tilled crops which benefit immensely from the organic nitrogen accumulated in the soil. This is a strong point, but the commonly expressed statement that new seedings yield more than older ones is the most persuasive argument against maintaining leguminous stands as long as possible. Probably that is true of the starved, mismanaged fields of ladino seen in this region.

To show that old fields of ladino-grass mixtures need not be less productive than young stands, the case of a 1939 seeding on the Agronomy Farm at the Storrs Experiment Station will be cited. That seeding, now over 15 years old, was established for the purpose of measuring the effects of various cutting systems on the stands and yields. For 10 years those systems were rigidly followed regardless of results. As will be pointed out later, some systems were favorable for the maintenance of ladino; others were not. But the fact to be emphasized here is that the average stands of ladino and the average yields of 18 plots with fairly favorable management were appreciably greater during the second than in the first five-year period. Both periods had the same number of "dry" and "wet" seasons. Furthermore, in the fourteenth complete harvest year, (1953)—incidentally a very dry season—ladino occupied about two thirds of the area on the entire field and the yields were the second largest in its long history!

Plenty of Plant Nutrients

Soils vary widely in their capacities to supply the 11 elements which have been found necessary for plants and which cannot be obtained from air and water. For this reason particularly, amounts of fertilizers are mentioned here to give the facts, and they are not recommendations for other regions.

There are no naturally fertile soils in Connecticut, and the pH values before the first liming are usually about 5.0. It is obvious, therefore, that lime and fertilizers must be added quite liberally for any worth-while crops. For such valuable perennial legumes as alfalfa and ladino, it is highly desirable, if not absolutely necessary, to lime to above pH 6 and supply at least 80 pounds per acre of "available" phosphoric acid (P_2O_5) before seeding. Without these basic treatments, failure to establish the legumes is almost a certainty. Some potash (usually not less than 80 pounds K_2O per acre) is also required to start alfalfa and clovers, but the greatest need for potash is during subsequent years when three to five tons per acre of dry forage, rich in minerals, are removed each season by cutting or grazing.

The 15-year-old stand of ladino at Storrs was seeded after liming and fertilizing the Charlton fine sandy loam soil more liberally than outlined above. After establishment it was topdressed each spring with enough 46% superphosphate and 60% muriate of potash to supply 70 pounds of P_2O_5 and 150

pounds of K_2O per acre. That yearly fertilization is equivalent to about 700 pounds of 0-10-20 or 500 pounds of 0-15-30. Besides the superphosphate and the potash, dolomitic limestone at one ton was added in 1945 and again in 1950.

Though considered liberal when planned in 1939, that annual PK treatment did not furnish as much potash as was removed in the forage during seasons of favorable rainfall; in fact, symptoms of potassium deficiency were noted on the ladino toward the latter parts of several summers. Other experiments here have demonstrated that somewhat greater efficiency and much less luxury consumption result if the potash is applied in smaller, more frequent doses.

But regardless of frequency and size of application, an ordinary yield of three tons per acre of ladino-grass dry matter, containing only a medium concentration of 2% potash (K_2O), removes 120 pounds from the soil each year. Since maximum yields have not been obtained at this Station with less than 180 pounds per acre of K_2O every season, and also because legumes cannot obtain enough potash for existence from soils where grasses grow fairly well, it is now recommended that ladino and alfalfa stands in Connecticut be fertilized with materials carrying about that amount of potash in one or more applications.

Harvesting Systems Important

In the preceding paragraphs it has been stated that soils must be well fortified with calcium, magnesium, phosphorus, and potassium for the successful establishment and maintenance of ladino or other forage legumes. Besides those four nutrient elements, Connecticut soils do not supply enough boron for alfalfa during periods of below average rainfall. But fertile soils or liberal fertilization will not assure long life for those legumes if the cutting or grazing management is faulty. Not only must the direct effects of harvesting on the legumes be considered, but also the indirect effects which may arise from the competition of accompanying species, favored by a system of management.

Fig. 3. Same as Fig. 2 except 100 lbs. of 60% muriate of potash were applied after every cutting (four cuts per year). Note the thickness of ladino in the stand.

Ladino is particularly vulnerable to the competition of grasses. Seeding the clover alone does not solve the problem for, in the Northeast at least, some grasses usually volunteer and spread rapidly under the favorable fertility conditions existing in soils growing perennial legumes. Planting a less aggressive grass, like timothy, is not the answer either, because it does not remain long in fields grazed or mowed as frequently as ladino should be. The only apparent practical method of maintaining a proper balance between legume and grass is to adjust the system of harvesting so as to favor the one which should be more prevalent. Usually any such system should favor the legume, the most important and least hardy plant in mixed stands.

To illustrate the effectiveness of harvesting systems on the prevalence of species in mixed stands, the case of the 15-year-old ladino at Storrs will be cited again. Seeded with orchard grass or timothy in 1939, those ladino-grass plots were exposed to 10 different cutting systems for 10 years (1940-1949). The timothy soon disappeared from all plots excepting those on which the first harvest each season was delayed until the early "hay" stage (June 15). With the

Fig. 4. This stand of ladino on the Agronomy Farm at Storrs is 15 years old. Management: Mowed when 8 inches to 2 inches; fertilization every year—150 lbs. of 46% superphosphate and 250 lbs. 60% muriate of potash; one ton of limestone every fifth year.

passing of timothy, Kentucky bluegrass volunteered and became the chief grass there. Thus, in this experiment, ladino was in competition with two of the most aggressive grasses common in the Northeast.

Without going into details, the most notable result was that during the last 6 of the 10 years, ladino was much more prevalent whenever the mower was set to cut two, rather than four inches above the ground. In the tenth season ladino occupied three times as much area on 18 plots where only two inches of stubble was left as on 18 comparable plots mowed four inches above the soil. As might be expected, the more prevalent the clover, the higher were the yields.

In spite of the rather liberal mineral fertilization, on areas with little ladino to supply nitrogen, the turf became nearly as weedy and unproductive as our never-fertilized permanent pastures!

The height of the forage when harvested was a much less effective factor than the height of the stubble. However, there was somewhat more clover and slightly larger yields of dry matter as the height attained between cuttings increased from 6 to 8 and to 10 inches. It should be mentioned, also, that good stands of ladino and high yields were maintained where the first harvest each season was postponed until June 15, with six-inch growth cut to two inches thereafter.

Why Low Mowing Is Effective

Although sometimes called "giant" white clover, ladino is a relatively low-growing plant. Every time the leaflets are removed, regardless of distance above the ground, the new growth starts from buds on the prostrate stems at the surface of the ground. In marked contrast grasses elongate from the point of leaf blade removal. Furthermore, evidence from other Stations shows that considerable amounts of carbohydrate reserves are stored by grasses in their leaf sheaths and the lower parts of their stems.

For these reasons ladino is exposed to much more shading and probably more below-ground competition for plant nutrients and water, when mixed clover-grass stands are mowed several inches above rather than close to the ground.

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Better Fruit With Trace Elements

By Benjamin Wolf

Bridgeton, New Jersey

RECENT results have shown that better fruit and more of it are often dependent upon including certain trace elements in the fertilization program. The trace elements, or minor elements as they are also called, have a profound effect upon the tree and the resulting fruit. In the past, it was considered that most soils contained sufficient amounts for tree nutrition. Today, it is apparent that continual cropping without returning sufficient trace elements has made many a sufficient soil now deficient. Also, because of our better knowledge and measurements of these elements, it is realized that addition of one or more of them may often be vitally important.

Just what are these elements and their function and where are they needed? If they are needed, how should they be applied?

The trace elements encompass a wide group of elements that are used rather sparingly by plants but are nevertheless essential for plant life. Since the term "trace" is a relative one, there is some difference of opinion among plant scientists as to what constitutes a trace element. For practical purposes, we can include in this group the vast number of elements essential for plant life other than nitrogen, phosphorus, and potassium (the "big three" carried in most mixed fertilizers) and carbon, hydrogen, and oxygen (elements obtained from the air or water). This would leave such elements as calcium, magnesium, boron, manganese, iron, copper, zinc, and molybdenum.

There are several others being considered as necessary for plant growth. Evidence to date is not at all conclusive that they are necessary. Several others which have been proven to be essential are seldom found to be deficient and need not be considered here. Let us consider individually the elements of the group that are essential and are deficient at times.

Calcium: Calcium is associated with cell formation. Lack of calcium usually results in dieback of terminal twigs or roots. This element is a constituent of liming materials and also of normal superphosphate. Where soils have been adequately limed, it is difficult to show response to additional calcium. Some deficiency has been suspected on light soils that hold relatively little calcium at suitable pH values. There is some question as to how this extra calcium should be applied, but sprays of soluble calcium salts such as calcium nitrate show some promise.

The average grower should consider his soil pH as an index of calcium. If pH is below 6.0, every effort should be made to add enough liming material to bring it to the proper pH.* If pH is 6.0 or slightly higher and available calcium is good, there is little need of additional treatments. If pH is over 6.0 and available calcium is low or if growth is less than satisfactory, technical help should be called in to advise on further calcium additions.

Magnesium: Magnesium is a normal part of chlorophyll, the green coloring matter of plants. Lack of magnesium gives light green color to area between veins of older leaves. Also, scorching or death of cells on edge of

* Blueberries do best at a pH of 4.0 to 5.5. They should not be limed unless pH is below 4.0 and lime should be used sparingly.

leaf is quite common. In mild deficiencies, no leaf symptoms are present but there may be an excessive drop of immature fruit. On some plants, particularly bush fruits, magnesium deficiency causes a purplish or reddish discoloration of the leaves. Magnesium, like calcium, is often supplied with liming materials. However, many liming materials do not carry sufficient magnesium to correct or prevent a deficiency. The amounts of available magnesium in the soil or leaves can readily be determined by quick chemical tests. If magnesium is low, dolomitic (high magnesium) limestone, containing at least 10% magnesium, should be used. If pH is already satisfactory, at least two units of soluble magnesia should be included in the fertilizer. Another convenient way of adding magnesium is by spraying Epsom salts (magnesium sulfate) directly to the leaves. About 10 lbs. can be used per 100 gallons. Epsom salts is compatible with most fungicides and insecticides.

Boron: This element, like calcium, is essential for cell formation. A lack of the element causes dieback of roots and shoots. Boron deficiency in apples is characterized by "measles" or scales of loose bark producing a characteristic pox. However, not all measles are due to boron deficiency. Shortages of boron cause internal or external cork in apple fruit. Peaches and citrus are misshapen when boron is low. Citrus fruits will often show hard spots and gum deposits in the rind, and pears and cherries will show cracking of fruit.

Boron deficiency is more common on soils that have been limed heavily. However, it may also appear on light, acid soils. Analysis of water-soluble boron in soils or total boron in leaves helps materially in diagnosing a deficiency.

In correcting boron deficiency, it must be remembered that there is a very narrow range between deficiency and toxicity for many plants. Peaches are extremely susceptible to overdose. Use of 5 lbs. borax (a carrier of boron) per acre in some cases will give increased vigor and better fruit, while use of 15 lbs. borax per acre can reduce fruit set and seriously injure the tree. It is, therefore, very important that a boron deficiency be accurately diagnosed. Apples are more tolerant to use of boron compounds and generally require higher dosage. Ten to 40 lbs. borax per acre can be applied depending upon soil type, deficiency, and age of trees.

The borax can be mixed in the fertilizer or applied as a spray. Much less is needed as a spray. Usually 1 to 2 lbs. borax per 100 gallons of water is sufficient to correct most deficiencies.

Manganese: Lack of manganese affects green coloring of leaves and a deficiency is apparent by yellowing or "chlorosis" between the veins. Manganese affects vigor of trees and is important from standpoint of frost and disease resistance. Deficiency usually occurs on slightly acid soils (pH 6.5-7.0) or alkaline soils (pH greater than 7.0). However, it might appear in light soils at lower pH.

Some control can be effected by lowering pH, particularly on heavier soils of good manganese content. However, if pH is not above 6.5 it will be generally more desirable to include manganese as manganous sulfate or oxide to the fertilizer. Requirements are 10 to 100 lbs. per acre depending on severity of deficiency. Quicker response can be obtained by sprays of manganous sulfate. One to two lbs. of manganous sulfate per 100 gallons makes a good corrective spray. Larger amounts of manganous sulfate are sometimes used, but it is best to combine such amounts with spray lime in order to prevent burning.

Iron: This element behaves much like managanese and in the early stages, symptoms are difficult to distinguish. In advanced stages, leaves are paper white. Growing points are affected

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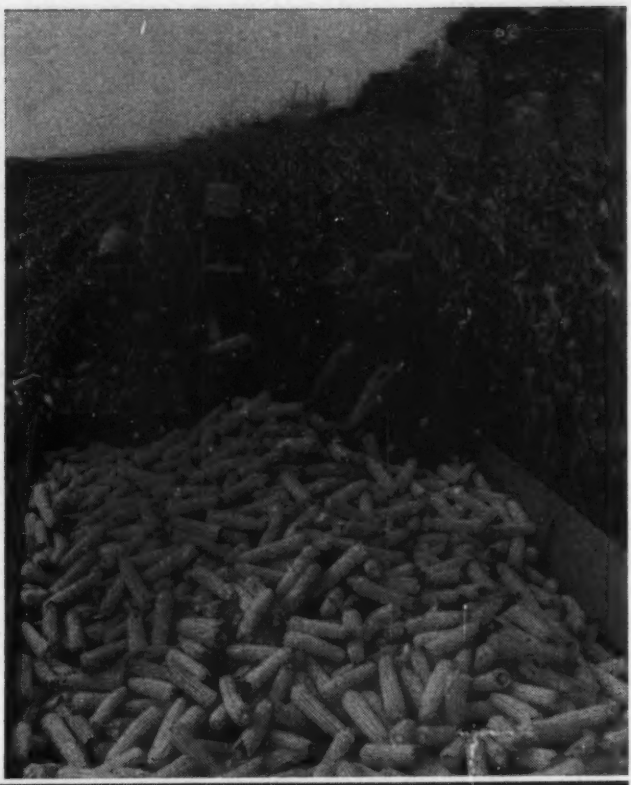
PICTORIAL

Autumn Days!

Above: Burley Tobacco in the Mountains

Left: Stripping Cane for Cutting

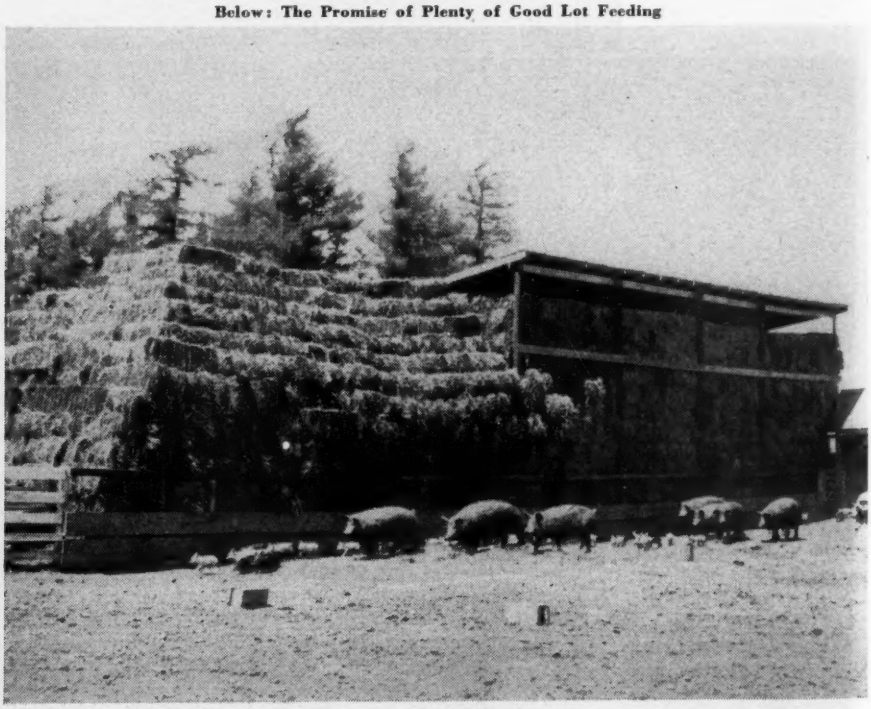


Right: Harvesting Corn on the Prairies

Below: A Field of California Onions

Above: Prepared for Supplementary Feeding on Pasture Land

Below: The Promise of Plenty of Good Lot Feeding



The Editors Talk

Our Cover Picture

The cover illustration this month shows the effect of potash in maintaining a stand of clover. Soil in the plot at the left contained insufficient potash, and the clover is disappearing. The plot at the right contained adequate potash, and the clover is growing vigorously.

Of course, there are other causes of clover failures. E. A. Hollowell says that many farmers plant clovers but do not reap a crop. The reasons for the failures might be several: The use of unadapted seed; a soil deficient in plant nutrients, particularly calcium, phosphorus, or potash; planting the seed in loose, cloddy seedbeds; failure to inoculate the seed with the proper strain of nodule-producing bacteria; and mismanagement of stands in grazing, clipping, or cutting. Even if all but one of the faults are corrected, complete or partial failures and low yields may still occur.

However, according to H. L. Ahlgren, forages capable of producing high yields of good quality cannot be established or maintained on impoverished soils. Increasing failures of red clover following long periods of cropping and the introduction of alfalfa with its highly exacting fertility requirements were factors of major importance in focusing attention on the need for improving the soil by use of lime and commercial fertilizer. As a result, applications of lime, phosphate, and potash on the basis of soil and plant requirements have become relatively common for the establishment and maintenance of seedings for use as rotation pasture or for hay and grass silage.

To Emil Truog must go much of the credit for establishing the relationship between potash and the successful growing of clovers and other legumes. In the October 1925 issue of this magazine, we were privileged to carry an article by him telling of his discovery of the signs or symptoms which definitely indicate potash hunger in alfalfa and clover. From this article we quote:

"While investigating the fertilizer needs of a large number of soils for growing alfalfa and clover by means of pot tests in the greenhouse, the writer noticed that wherever potash was the limiting element or factor, definite and characteristic white spots, the size of small pin heads, appeared on some of the alfalfa leaves. These white spots first develop around the border of the leaf and usually form a more or less definite pattern-like marking. Later on, spots develop towards the center and the border becomes yellow, curls down, and dries up. The portion along the midrib is the last to be affected. Irregular white or gray blotches due to insects and diseases, that often appear anywhere on alfalfa leaves, should not be confused with these white spots which always appear on the border first, more or less regularly placed. When potash starvation exists, it is always possible to find some leaves which show the symptoms so characteristically that mistakes should not occur.

"The spots always appear on the older leaves. At first only a few leaves are affected. When potash deficiency occurs as the plant develops, the plant removes some of the potash from the older leaves and sends it to the newer growing

portions. This is nature's provision in trying to make it possible for the plant to reach maturity and produce seed even though something is lacking.

"When these white spots are examined with a hand lens there appears to be a depression wherever a spot exists. Evidently some of the plant tissue has broken down with the removal of the potash. Since chlorophyll, the green colored material, disappears, it indicates that potash is closely associated with chlorophyll. It has been known for a long time that potash is essential in starch formation, which process is carried on by the chlorophyll.

"Potash starvation in clover is indicated by spots which appear similarly placed. The spots are, however, not white but yellow to brown in color. They are not as easily seen as in alfalfa, but their position and appearance on the older leaves should make it fairly easy to distinguish them.

"Wherever potash was applied to potash-deficient soils in the greenhouse tests, these spots did not appear. The fertilization of affected plants with potash also caused the spots to disappear. Upon investigation, these same symptoms were found in the field, and here, as in the greenhouse, potash fertilization caused the spots to disappear and the crop to improve.

"The importance of potash fertilization for alfalfa, clover, and other legumes is, as yet, not fully appreciated in this country. Many failures with alfalfa and clover are due to a lack of available potash. The importance of lime and phosphate has been quite fully emphasized. The same cannot, however, be said in regard to potash. Few people realize that alfalfa or clover hay contains as much potash as it does lime. A ton of alfalfa or clover hay requires as much potash as there is in 75 pounds of muriate of potash. It should be emphasized that alfalfa, clover, and most legumes, are 'potash loving' as well as 'lime loving'."

It is fortunate that it is relatively easy to recognize potash deficiency symptoms in most of our clovers, since this element is of such great importance in maintaining a healthy growth of plants and thereby a long-lived stand. The prudent grower, however, will be well advised to test his soil to be sure that it contains all of the nutrients necessary for good growth, rather than wait until trouble appears before taking corrective action.

"THIS is a marvelous time for imaginative scientists to work in one of the greatest of all professions—Agriculture. Never have the advances of science and technology in our industry been more rapid or far-reaching than in this generation. Conversely, seldom have the problems we face been more profound. Yet our principal problem in agriculture is really a happy one. How much better to wrestle with 'too much' rather than 'too little,' as is the case in most of the world.

"Our abundant agricultural production reflects in large part the high degree of efficiency in agricultural production and marketing. Yet I am confident that in a few years we will look back upon 1954 and wonder how we could have been so inefficient just a few years earlier.

"The scientific and technological advances we will experience in the next decade will be unparalleled in the history of American agriculture. The geographic frontier in American agriculture is gone. No longer can a young man 'go West' and stake out his claim. But the scientific frontier in America is barely scratched. And the scientific frontier has no effective limit. It is limited only by the mind and the imagination of man. Organized and imaginative research, in both production and distribution, is the factor which will push our scientific frontier beyond limits we scarcely dare dream of today." . . . *Earl L. Butz, Assistant Secretary of Agriculture.*

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951.....	37.9	51.1	163.0	304.0	166.0	211.0	19.50	69.30	....
1952.....	36.9	50.0	196.0	331.0	157.0	209.0	21.05	70.00	....
1953									
September...	33.09	57.6	98.9	264.0	150.0	192.0	16.15	51.50	....
October.....	32.46	52.6	89.7	233.0	134.0	194.0	16.45	52.40	....
November...	31.82	42.3	83.4	232.0	133.0	200.0	17.25	53.40	....
December....	30.73	49.2	69.9	246.0	141.0	201.0	18.25	53.00	....
1954									
January.....	30.05	48.3	69.1	253.0	142.0	203.0	19.05	52.00	....
February....	30.42	31.9	65.3	258.0	143.0	206.0	18.95	51.40	....
March.....	31.05	27.3	53.2	252.0	144.0	209.0	18.35	50.50	....
April.....	31.57	....	70.2	268.0	145.0	206.0	18.05	50.80	....
May.....	32.17	58.0	134.0	263.0	147.0	200.0	17.05	51.40	....
June.....	32.31	53.0	151.0	270.0	149.0	191.0	15.65	51.40	....
July.....	32.18	52.7	149.0	302 0	150:0	200.0	15.15	54.00	....
August.....	34.00	48.2	141.0	259.0	153.0	203.0	16.45	61.30	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1928.....	145	200	76	134	131	113	95	152	147
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	128
1931.....	46	82	66	83	50	44	73	40	107
1932.....	52	105	55	62	50	43	52	46	100
1933.....	82	130	118	79	81	84	68	57	90
1934.....	100	213	64	91	127	96	111	146	94
1935.....	90	184	85	80	102	94	83	135	116
1936.....	100	236	164	106	163	116	94	148	108
1937.....	68	204	76	89	81	109	74	87	114
1938.....	69	196	80	79	76	64	57	97	96
1939.....	73	154	100	84	88	78	67	94	98
1940.....	80	160	78	97	96	77	64	96	122
1941.....	137	264	116	105	117	107	82	211	138
1942.....	153	369	168	134	143	124	91	202	178
1943.....	160	405	188	235	174	154	125	231	270
1944.....	167	420	214	216	170	160	139	234	236
1945.....	181	366	205	232	198	170	127	227	240
1946.....	263	382	178	248	212	209	141	319	217
1947.....	257	380	232	248	336	259	148	381	262
1948.....	245	482	222	253	201	226	155	298	253
1949.....	231	459	184	244	193	213	139	192	232
1950.....	323	517	132	197	238	226	141	384	211
1951.....	306	512	233	346	259	239	164	307	269
1952.....	298	500	281	377	245	236	177	310	274
1953									
September...	267	576	142	301	234	217	136	228	159
October.....	262	526	129	265	209	219	139	232	175
November...	257	423	120	264	207	226	145	237	186
December....	248	492	100	280	220	227	154	235	224
1954									
January.....	242	483	99	288	221	230	160	231	271
February....	245	319	94	294	223	233	160	228	233
March.....	250	273	76	287	224	236	155	224	246
April.....	255	....	101	305	226	233	152	225	225
May.....	259	580	192	300	229	226	144	228	279
June.....	261	530	217	308	232	216	132	228	200
July.....	260	527	214	344	234	226	128	239	243
August.....	274	482	202	295	238	230	139	272	223

Wholesale Prices of Phosphates and Potash **

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports [2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports [2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952	.849	3.98	5.47	.401	.793	15.25	.200
1953							
September	.895	....	....	.396	.768	14.72	.193
October	.895	....	....	.396	.768	14.72	.193
November	.895	....	....	.396	.768	14.72	.193
December	.895	....	....	.430	.827	16.00	.210
1954							
January	.895	....	....	.430	.827	16.00	.210
February	.895	....	....	.430	.827	16.00	.210
March	.895	....	....	.430	.827	16.00	.210
April	.895	....	....	.430	.827	16.00	.210
May	.895	....	....	.430	.827	16.00	.210
June	.895	....	....	.359	.710	13.45	.174
July	.895	....	....	.388	.765	14.75	.184
August	.895	....	....	.388	.765	14.75	.184
			Index Numbers (1910-14 = 100)				
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952	158	110	112	72	83	63	83
1953							
September	167	...	...	71	81	61	82
October	167	...	...	71	81	61	82
November	167	...	...	71	81	61	82
December	167	...	...	76	87	66	85
1954							
January	167	...	...	76	87	66	85
February	167	...	...	76	87	66	85
March	167	...	...	76	87	66	85
April	167	...	...	76	87	66	85
May	167	...	...	76	87	66	85
June	167	...	...	66	75	56	79
July	167	...	...	70	80	61	81
August	167	...	...	70	80	61	81

Wholesale Prices of Ammoniates **

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952	3.34	2.09	13.95	11.27	9.72	9.16
1953						
September	3.09	2.28	9.82	11.04	7.51	6.91
October	3.09	2.25	9.73	11.24	7.96	7.75
November	3.09	2.22	9.61	11.24	8.19	8.19
December	3.09	2.22	10.96	11.24	8.50	9.03
1954						
January	3.09	2.22	11.28	11.24	9.26	9.71
February	3.09	2.22	11.20	11.45	9.34	10.02
March	3.09	2.22	11.35	11.70	9.59	10.20
April	3.09	2.22	11.63	12.15	10.32	10.55
May	3.09	2.22	11.40	12.15	11.47	10.74
June	3.09	2.18	10.76	12.15	10.09	9.87
July	3.09	2.18	11.12	11.28	10.02	9.87
August	3.09	2.18	12.37	11.19	9.83	11.19
	Index Numbers (1910-14 = 100)					
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952	125	74	399	319	288	260
1953						
September	115	80	281	313	223	196
October	115	79	278	318	236	220
November	115	78	275	318	243	233
December	115	78	313	318	252	257
1954						
January	115	78	322	318	275	276
February	115	78	320	324	277	285
March	115	78	324	331	285	290
April	115	78	332	344	306	300
May	115	78	326	344	340	305
June	115	76	307	344	299	280
July	115	76	318	320	297	280
August	115	76	353	317	292	317

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and all Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1928.....	148	152	141	121	87	177	108	97
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	124	130	127	86	56	130	102	77
1942.....	159	149	144	93	57	161	112	77
1943.....	193	165	151	94	57	160	117	77
1944.....	197	174	152	96	57	174	120	76
1945.....	207	180	154	97	57	175	121	76
1946.....	236	197	177	107	62	240	125	75
1947.....	276	231	222	130	74	362	139	72
1948.....	287	250	241	134	89	314	143	70
1949.....	250	240	226	137	99	319	144	70
1950.....	258	246	232	132	89	314	142	72
1951.....	302	271	258	139	93	331	152	76
1952.....	288	273	251	144	98	333	158	76
1953								
September.	256	259	249	137	97	258	167	75
October...	250	258	248	137	96	265	167	75
November.	249	259	247	137	96	267	167	75
December..	254	260	248	141	96	285	167	80
1954								
January...	259	263	250	142	96	300	167	80
February..	258	264	248	142	96	301	167	80
March....	256	264	250	143	96	307	167	80
April.....	257	265	250	145	96	323	167	80
May.....	258	267	250	147	96	338	167	80
June.....	248	265	248	141	95	311	167	69
July.....	247	263	248	142	95	310	167	74
August....	251	264	248	143	95	319	167	74

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] Potash salts quoted F.O.B. mines; manure salts since June 1941; other carriers since June 1947. Beginning June 1954, muriate of potash quoted on both mine and port basis.

**** Where range of prices for fertilizer material is quoted, average figure is used. The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Citrus Fertilization," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Lflt. 17, Nov. 1953, J. C. Johnston.

"Avocado Fertilization," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Lflt. 24, Jan. 1954, G. E. Goodall.

"Effect of Fertilizers and Lime on Yield of Clovers and Fescue in North Florida," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Cir. S-70, Feb. 1954, L. G. Thompson, Jr.

"Annual Report, State Chemist of Florida, Fertilizers, Feeds, Foods, Drugs, and Cosmetics, Pesticides and Seeds, Year Ending December 31, 1953," Dept. of Agr., Tallahassee, Fla.

"Yield and Composition of Corn Forage as Influenced by Soil Fertilization," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 577, June 1954, K. E. Harshbarger, W. B. Nevens, R. W. Touchberry, A. L. Lang, and G. H. Dungan.

"Higher Crop Yields from Improved Soils," Agr. Ext. Serv., Purdue Univ., Lafayette, Ind., Mimeo. AY 57a, May 1954.

"Nitrogen Sidedressing on Corn, Demonstration Results, 1952," Soil Series No. 38, H. E. Jones; "Nitrogen Sidedressing on Corn, Demonstration Results, 1953," Soil Series No. 39; H. E. Jones and C. A. Simkins; Agr. Ext. Serv., Univ. of Minn., St. Paul 1, Minn.

"Commercial Fertilizer Results with Winter Wheat and Rye, 1954," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Cir. 38, Aug. 1954, G. W. Lowrey, R. A. Olson, A. F. Dreier, and P. L. Ehlers.

"Potash and Magnesium Fertilization of Young Pine and Spruce Trees," N. Y. State College of Agr., Ithaca, N. Y., S. O. Heiberg, E. L. Stone, and D. P. White.

"Wheat Fertilization Studies in Western Oklahoma; Progress Report, 1951-52 and 1952-53," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Bul. B-432, July 1954, H. V. Eck and B. A. Stewart.

"Fertilizer and Cover Crop Tests with Elberta Peach at Montague," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1695, June 1954, U. A. Randolph.

"Grain Sorghum Fertilizer Trials, High Plains of Texas, 1953," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1700, July 1954, J. Box and D. L. Jones.

"Cotton Fertilizer Trials, High Plains of Texas, 1953," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1701, July 1954, J. Box and D. L. Jones.

Soils

"Citrus Soil Management," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Lflt. 19, Nov. 1953, J. C. Johnston.

"Citrus Irrigation," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Lflt. 20, Nov. 1953, J. C. Johnston and R. W. Southwick.

"De Soto County Soils," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 511, Feb. 1954, E. J. McNutt and H. B. Vanderford.

"Properties Affecting Water Relations and Management of 14 Mississippi Soils," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul 521, June 1954, W. M. Broadfoot and W. A. Raney.

"Irrigation Well Waters of New Mexico, Chemical Characteristics, Quality, and Use," Agr. Exp. Sta., N. Mex. A. & M. College, State College, N. Mex., Bul. 386, June 1954, H. E. Dregne and H. J. Maker.

"Liming N. C. Soils," Agr. Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. 380, March 1954, C. D. Welch.

"A Manual on Conservation of Soil and Water," USDA, Wash., D. C., Agr. Handbook 61, June 1954.

"Soil Survey, Alachua County, Florida," USDA, Wash., D. C., Series 1940, No. 10, Feb. 1954.

"Soil Survey, Tuscarawas County, Ohio," USDA, Wash., D. C., Series 1938, No. 32, Dec. 1954.

Crops

"Rice Varietal Tests, 1948-1953," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Mimeo. Series 22, March 1954, T. H. Johnston and E. M. Cralley.

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"Thirty-Fourth Annual Report, Period Ending December 31, 1953," State Dept. of Agr., Sacramento, Calif., Vol. XLII, #4.

"Plum Culture," Dept. of Agr., Ottawa, Ont., Canada, Pub. 849, March 1954, D. S. Blair.

"The Prairie Home Orchard," Exp. Farms Serv., Dept. of Agr., Ottawa, Ont., Canada, Pub. 901, April 1954, W. R. Leslie.

"1953 Annual Report," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Bul. 582, Feb. 1954.

"Growing Soybeans—in Georgia," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Cir. 310, Feb. 1954, J. R. Johnson.

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"Crops for Emergency Plantings," Agr. Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 726, June 1954, W. O. Scott.

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"Methods of Planting Coastal Bermuda Grass at the West Louisiana Experiment Station," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. 485, March 1954, H. E. Harris and C. B. Roark.

"Extension at Work," Agr. Ext. Serv., Univ. of Md., College Park, Md., 39th Ann. Rpt., 1954.

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"Mississippi Cotton Variety Tests, 1953," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 509, Jan. 1954, J. F. O'Kelly, S. P. Crockett, B. C. Hurt, and K. C. Freeman.

"Balanced Farming Helped Farmers Through the Drouth, Annual Report, 1953," Agr. Ext. Serv., Univ. of Mo., Columbia, Mo., Cir. 650, May 1954.

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"Turf Management on Athletic Fields," Agr. Ext. Serv., Rutgers Univ., New Brunswick, N. J., Lflt. 119, April 1954, R. E. Engel and G. H. Ahlgren.

"The Culture of Gladiolus," Agr Ext. Serv., Cornell Univ., Ithaca, N. Y., Ext. Bul. 914, March 1954, R. E. Lee.

"Farm and Home Garden Manual," Agr. Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. 122, Feb. 1954, J. H. Harris and H. M. Covington.

"Grain Sorghum (Milo) Production," Agr. Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. 382, April 1954, P. H. Harvey, B. A. Krantz, J. B. Smith, and J. H. Marion.

"Roses," Agr. Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Fldr. 104, Jan. 1954.

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"Hayes and Patrick Pecans, New Varieties for the Cracking Trade," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Bul. B-427, June 1954, F. B. Cross, H. A. Hinrichs, and H. J. Thomson.

"Cotton Variety Tests, 1953," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Mimeo. Cir. M-257, March 1954, J. M. Green, E. S. Oswalt, J. W. Simmons, and N. M. Gober, Jr.

"Progress Report of Grazing Experiments; 1945-1953, Southeast Oklahoma Pasture Fertility Research Station, Coalgate," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Mimeo. Cir. M-263, June 1954, J. Q. Lynd, W. C. Elder, and R. Totusek.

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"Corn Hybrids for Texas," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Bul. 776, May 1954, T. E. McAfee and J. S. Rogers.

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Tex., Prog. Rpt. 1688, June 1954, E. B. Hudspeth and D. L. Jones.

"Cotton Variety Tests, Brazos River Valley Laboratory, 1951-53," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1689, June 1954, J. E. Roberts and D. T. Killough.

"Cotton Variety Test at Prairie View, 1951-53," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1690, June 1954, O. E. Smith and J. C. Williams.

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"Perennial Warm Season Grass Test, Lower Rio Grande Valley of Texas," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1698, July 1954, J. H. Barton.

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"Report of the Virgin Islands Agricultural Research and Extension Program, 1953," USDA, Wash., D. C., 1954.

"Extension Activities and Accomplishments, 1953," USDA, Wash., D. C., Ext. Serv. Cir. 494, May 1954, A. S. Gordy.

Economics

"Agricultural Statistics for Ontario, Year 1953," State Dept. of Agr., Toronto, Ont., Canada.

"Colorado Agricultural Statistics, 1952 Final, 1953 Preliminary," State Dept. of Agr., Denver, Colo., Vol. 1, No. 4, Jan. 1954.

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"Indiana Crops and Livestock," Agr. Exp. Sta., Purdue Univ., West Lafayette, Ind., No. 339, Dec. 1954.

"Economic Instability and Choices Involving Income and Risk in Primary or Crop Production," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Res. Bul. 404, Jan. 1954, E. O. Heady, E. W. Kehrberg and E. H. Jebe.

"Farm Income and Living Costs, 1946-50, Agr. Exp. Sta., Kansas State College, Manhattan, Kansas, Bul. 363, Feb. 1954, M. G. Correll.

"Marketing Fresh Sweet Corn in the Midwest," Agr. Exp. Sta., Univ. of Minn., St. Paul 1, Minn., Sta. Bul. 427, June 1954, J. D. Winter, R. E. Nylund, and R. W. Cox.

"Dairying with a Future," Agr. Ext. Serv., Univ. of Minn., St. Paul 1, Minn., Ext. Bul. 276, June 1954, R. W. Wayne, H. R. Searles, and R. D. Leighton.

"Know Your Farm Business," Agr. Ext. Serv., Univ. of Minn., St. Paul 1, Minn., Ext. Pamph. 138, March 1954, T. R. Nodland.

"Know Your Minnesota Potatoes," Agr. Ext. Serv., Univ. of Minn., St. Paul 1, Minn., Ext. Fldr. 183, Aug. 1954, E. Loomis and O. C. Turnquist.

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"Factors Related to Levels of Living of Oklahoma Farm Families," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Bul. B-429, July 1954, O. D. Duncan.

"Crop and Livestock Opportunities on Eastern Oklahoma Prairie Land Farms," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Bul. B-430, July 1954, W. F. Lagrone.

"Some Factors Influencing Mineral Rights Separation in Land Sales," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Bul. B-431, July 1954, L. A. Parcher.

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"Oklahoma Farm Production Prospects for 1954," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Mimeo. Cir. M-256, March 1954.

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Accounts Data," USDA, Wash., D. C., Agr. Inf. Bul. 101, May 1954, J. L. Pennock, M. L. Brew, and R. C. Tillinghast.

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Principles Involved in Soil Testing

(*From page* 12)

pure, and since only a portion becomes available before crop harvests and leaching remove calcium, the application of average agricultural limestone as indicated by exchangeable hydrogen measurements will approximate the 75% saturation for calcium figures given in Table IV. If limestone is of coarser grind or low in purity, then the quantities added must be increased. For determining the limestone need, the exchangeable calcium, the exchangeable magnesium, the hydrogen, and the pH measurements should all be considered.

Phosphorus, One of the Anions

Much less is known about the chemistry and behavior of phosphorus in the soil than of the cation nutrients. It has been shown that on low phosphorus soils, the efficiency of absorption of available phosphorus by plants from starter fertilizer placed near the seed is seldom over 20% the first year. The remainder is "fixed" in a very slowly available form. To eliminate phosphorus as a factor in crop production by row application requires amounts that may be harmful to germination. If dry summer weather occurs, the roots will be below the area of fertilizer application, and the fertilizer will be inefficiently used. If the applied phosphate is mixed in the plow layer, much will be "fixed" and the rate of application must be increased to obtain maximum response.

In Missouri the extraction of the soil by the ammonium fluoride-hydrochloric acid solution developed by Bray is used. Laboratory results have correlated well with field response in most cases. For corn, soybeans or oats, little response has been obtained from added phosphate when the soil tests show 100 to 125 pounds of available phosphate per acre. For wheat and legumes a test of 200 pounds is adequate on most soils.

On soils low in phosphorus, or high in exchange capacity, and where cropping sequences include legumes or where pasture improvement is in the plan, both the rebuilding of the nutrient reserves with rock phosphate and the use of starter fertilizer at the time of planting have been the practices found satisfactory. Where only nonlegumes are grown, superphosphate is preferred. To spread the initial cost of superphosphate over a longer time this is usually applied as a split application (100 pounds phosphoric acid in each of two applications). When soils are very low in this nutrient (20 pounds or less per acre) and it is desired to have a reserve of 200 pounds of it in the surface layer, the soils of high exchange capacity and clays of the swelling type, found in the northern part of the State, have generally given better response to rock phosphate than those of low adsorptive content and those in South Missouri containing a large percentage of kaolin. Crops with

Fig. 5. Field experimental work must be conducted to correlate with soil tests.

a high calcium requirement and having a high exchange capacity of the roots (Table V) have given the greatest response to rock phosphate.

The failure to obtain representative soil samples is the weakest link in soil-testing programs. Short cuts in laboratory methods have been made and some accuracy has been sacrificed to increased speed. Even then the laboratory procedures introduce fewer errors than those by samples which are not representative. There appears to be little benefit in refining laboratory procedures further unless the sampling errors are reduced.

TABLE V.—CATION EXCHANGE CAPACITY OF PLANT ROOTS. (DATA BY DRAKE, MASS. STATE).

Crop	Ultimate pH	Cation exchange capacity m.e./100 gms.
Soybeans	3.26	58.9
Red clover	3.37	47.5
Alfalfa	3.42	48.0
Ladino	3.43	43.3
Orchard grass	3.72	24.9
Timothy	3.78	22.6
Kentucky bluegrass	3.83	21.6
Corn	3.68	26.0
Oats	3.78	22.8
Barley	4.25	12.3
Wheat	4.70	9.0

The variations in the soil tests of composite samples (10 borings) on approximately 5-acre areas in a 35-acre field with an average 6% slope on Menfro silt loam are shown in Table VI. In the individual areas the ranges in test results were from 1.3 to 1.8% for the organic matter, 12 to 136 pounds for the phosphate, 160 to 335 pounds for the exchangeable potash, 250 to 1,260 pounds for the exchangeable magnesium, and 1,300 to 1,800 pounds for the exchangeable calcium per acre. The pH varied from 4.9 to 5.3 and the exchangeable hydrogen was present in amounts ranging from 2.5 to 7.0 m.e. Although the averages of these eight

separate determinations do not vary widely from the values for the composite sample from the entire field, many samples will show greater variation. Anyone making suggestions on fertilizer needs can make these more accurately by knowing the soil variations within a field than if only one set of average figures is available.

Effort is being made in Missouri to have a single soil sample represent no more than 7 to 10 acres, regardless of field size.

Summary

The values of nutrients suggested by soil tests have shown satisfactory correlations with field response only when used as a measure of nutrient reserve rather than an indication of the kind of starter fertilizer needed. When crop yields were regulated largely by the release of nitrogen from soil organic matter, many soils could supply sufficient minerals. The increased use of chemical nitrogen and the improved yields in the past five years have increased the need for other essential minerals. Past management, particularly legume removal, erosion, and heavy soil treatments, have produced soil variations that can be rapidly assessed only by soil analyses. Experimental work has suggested that on soils with a high exchange capacity, the percentage of the total ionic capacity of the exchange complex should be the following various cations: 20 pounds per m.e. exchange capacity for potassium; 70 to 80% for calcium; 10% for magnesium; and 10 to 20% for hydrogen. The levels of these elements in a soil can be determined readily from soil tests.

The principal weakness in soil tests is the use of soil samples that are not representative. Laboratory procedures are generally more accurate than are the sampling methods.

TABLE VI.—SOIL TESTS ON COMPOSITE SAMPLES (10 BORINGS) FROM 5-ACRE AREAS IN A 35-ACRE FIELD—MENFRO SILT LOAM WITH A 6% SLOPE.

Sample No.	O.M. %	P_2O_5 lbs.	K lbs.	Mg lbs.	Ca lbs.	pH	H m.e.	Exchange Cap. m.e.
1	1.4	136	260	1260	1700	4.9	7.0	16.8
2	1.4	40	240	1140	1300	4.5	6.5	14.8
3	1.3	25	220	990	1300	5.0	3.5	11.1
4	1.8	17	190	600	1500	5.2	3.0	9.5
5	1.7	13	190	280	1500	5.1	3.5	8.7
6	1.8	48	250	250	1700	5.3	2.5	8.1
7	1.7	13	335	1000	1800	5.2	3.0	12.1
8	1.5	12	160	820	1400	4.9	5.0	12.1
Average	1.57	43	206	662	1525	5.01	4.25	11.0
Composite*	1.7	30	220	640	1500	5.1	3.5	10.1

* 10 borings from entire field.

Longer Life for Ladino

(*From page* 24)

Ladino Came Back

After the 10 years of formal cutting experiments all of the 60 plots on the field were mowed on the same dates, four times each season and about two inches above the ground. The same annual fertilization with superphosphate and muriate of potash was continued.

These plots were kept for three reasons:

1. To measure the residual effects of the great variations in ladino stands caused by 10 years of differential cutting

systems.

2. To have the plots for demonstrating to visitors that ladino seedings can be maintained for many years.

3. To serve as a source of possibly superior strains of ladino for breeding and selection projects.

Under the same harvesting system from 1950 to 1953 it was found that there was a positive correlation between prevalence of ladino and yields. It was clear however, that as the areas occupied by the clover reached 55 to 60%, yields did not increase markedly with additional proportions of the legume.

But the most significant result from the last four years' work with this project was the rather rapid spread of ladino on some plots where it had been reduced to relatively low levels by unfavorable cutting systems during the 1940-1949 period. Without any seeding, the clover increased on numerous plots from less than 20 to more than 50% in three seasons. In fact such changes were so general that by 1953 the entire field had a uniformly high (over 60%) stand of ladino. And on its fifteenth anniversary in the spring of 1954 there were no indications that this ladino would not remain vigorous and productive for many years to come.

In conclusion, then, it has been demonstrated that, given favorable management and liberal fertilization, especially annual or more frequent doses of potash, ladino will maintain good stands, even in competition with aggressive grasses and on the naturally infertile soils of New England, for much longer than commonly occurs. In other words, the life expectancy of ladino should far exceed the presently existent averages. It has also been shown that well-managed and liberally fertilized stands of ladino may be as productive 10 or 15 years after seeding as during the first or second harvest seasons. And finally it should be emphasized that prolonging ladino stands is the most effective conservation measure to keep the irreplaceable topsoil on our still verdant hillsides.

Better Fruit With Trace Elements

(*From page* 26)

and severe iron deficiency is accompanied by considerable dieback and finally death of the plant.

Deficiencies occur primarily on soil low in iron and, like manganese, deficiencies are aggravated by high pH. Many Florida soils are particularly low in iron, and use of iron for citrus has become quite common. Less known is the fact that extremely light soils of the coastal plain in New Jersey, Delaware, Maryland, and the Carolinas may also be low in iron. When such soils are elevated to a pH of 6.5, iron deficiency on peaches will readily result. Iron chlorosis is also common in alkaline soils in the West.

Until recently, iron deficiency has been difficult to treat since readily available iron applied to soils as ferrous sulfate or copperas changed quickly to ferric or non-available forms. Sprays of ferrous sulfate (¼ lb. per 100 gal.) plus several tablespoons sulfuric acid to maintain iron in available state were used. Also, sprays of ferrous citrate or ferric ammonium citrate (½ lb. per 100 gal.) were employed. These were temporary measures that only did a partial job and needed repeating. Recent work by Florida scientists has pointed to use of chelated iron as a corrective. Chelated iron (Fe EDTA) applied at rate of 3 lbs. per acre has corrected iron deficiencies of a number of plants including blueberries, oranges, grapefruit, and lemons. It has also been sprayed on at various rates, with rates of 1 to 6 lbs. per 100 gallons showing some success. However, sprays

have been toxic under certain conditions, particularly on young leaves. As a result, it would appear more desirable for the present to use ground applications. Correction of iron chlorosis on acid soils has been remarkable. Work is now under way to develop material also of value on alkaline soils.

Copper: General symptoms of copper deficiency are lack of green color between leaf veins (interveinal chlorosis), poor or no shoot growth, and dieback of branches in severe cases. Deficiency in citrus has been noted in wide areas in Florida. Here it is accompanied by dieback of tree and increased susceptibility to disease and frost. In peaches, copper deficiency is accompanied by interveinal chlorosis, marked curving or hooking of the leaves, and dieback. Where deficiency is slight, a small amount of copper sulfate (5 lbs. per acre) will vastly improve color of peaches and apple fruits. On organic soils, copper deficiency is rather common, and generally larger amounts of copper sulfate are required.

Copper sprays have been used for years to control melanose in citrus. There is no doubt the copper applied has had an important nutrient function as well, for copper sprays can correct copper deficiency. Usually a few pounds of copper sulfate are combined with about 5 lbs. hydrated lime per 100 gallons of spray.

Where considerable copper has been applied over a number of years in the fertilizer and the sprays, it is possible to build up toxic amounts of copper. This high level of copper interferes with iron nutrition and has been corrected in some cases with applications of chelated iron. The Florida Citrus Experiment Station suggests that a copper content of 150 lbs. per 6-inch acre of soil causes chlorosis or iron deficiency of citrus.

Zinc: A deficiency of zinc in a number of plants leads to "little leaf" or rosetting. As the name implies, leaves are small and rather pointed. They also may become prematurely yellow and fall. This gives some twigs a stringy look. Entire branches may die if deficiency is severe.

Adding zinc in such cases usually improves vigor of tree. Leaves are larger and greener. In some cases about 10-25 lbs. of zinc sulfate can be applied per acre to give good correction. However, many soils fix or immobilize applied zinc. In tests on certain New Jersey soils, it took 25 lbs. zinc sulfate per tree or about 1,500 lbs. per acre as a ground application to correct zinc deficiency on apples. Such applications are not at all economical. On such soils, it is best to apply zinc as a spray. The application of 5-10 lbs. zinc sulfate per 100 gallons as a dormant spray has corrected zinc deficiency on both peaches, apples, cherries, and plums. The spray must be applied before buds begin to open.

A neutral zinc has appeared on the market and has been suggested for summer sprays for peaches. This may prove to be the best way to apply zinc.

Molybdenum: This element has only recently been shown to be essential for plants. A deficiency in citrus has been proven in Florida and is known as "yellow spot." Lack of molybdenum in plums causes small leaves with brown areas which may be mottled.

Molybdenum is less available in acid soils and becomes more available with liming. It is probable that part of poor response in cases of low pH is due to lack of molybdenum. However, no definite symptoms of molybdenum deficiency have yet been diagnosed for fruit other than citrus.

In citrus, correction of molybdenum deficiency has been accomplished by addition of 2-3 ounces of molybdic oxide or sodium molybdate per 100 gallons and applied as a spray.

While many orchards may show deficiencies of one or more of the above elements, there are a great number of orchards which require no special treatment for the time being. Further cropping without replacement may make them deficient in the future. In such

cases, it may be wise to apply sufficient elements to replace those removed by the tree or lost from the soil in one way or another. However, there is no simple formula for either prevention or correction. Each case is individual, depending upon the soil, cropping that has taken place, extent of fertilization, liming, and many other factors.

It must be remembered by the orchardist that much yield and quality of fruit as well as vigor of tree can be lost before marked symptoms are apparent. Mild deficiencies generally do not give striking symptoms but can easily rob 30% of yield and much more of quality. It is well to remember also, that there is a very narrow range on several of these elements between deficiency and toxicity. Dosing without a basis for such treatment can lead to severe toxicity. It is important, therefore, that in arriving at a solution of the problem, the orchardist seek as much technical help as he can muster. Soil tests and analysis of leaves can supply real help if this information is in the hands of an expert. This same expert should be able to read the signs on trees and leaves.

All this information combined and put in its proper place should result in a working program to correct deficiencies or to prevent them. Such a program has been put to test in a half dozen states on apples, peaches, cherries, plums, and citrus with marked practical results. The cost of supplying the trace elements is rather low, being under $10.00 per acre in nearly all cases and generally about $5.00 per acre. This is a small cost for large returns in yield, quality, frost protection, and general vigor. In this period of generally high costs, no grower can afford to overlook the possibility that lack of trace elements may be robbing him of a good portion of his potential return.

Good Farming and Fertilization Both Necessary for High Yields

HEAVY fertilization does not eliminate the need for a good cropping system and good farming. If you depend on fertilizers alone to raise yields, you'll probably get only about half the possible increase. That's what eight-year tests at the University of Illinois show. A. L. Lang, Soil Fertility Specialist, says you'll get consistently high yields only if you combine above-average farming with above-average fertilization.

Illinois tests show that legumes and adequate fertilization consistently gave annual increases of 38 bushels of corn per acre on 12 dark-colored soils. Light-colored soils responded to this good management by averaging a 57-bushel increase in corn production.

Lang points out that a good farming operation must include a good catch crop or stand-over legume in the rotation every four or five years. This will supply most of the needed nitrogen and furnish vital soil organic matter. In these eight-year-long tests, fertilization needs were supplied by limestone, rock phosphate, and potash to meet the full requirements shown by soil tests.

"Illinois' Morrow Plots, the nation's oldest soil experiment fields, really prove that it takes both legumes and fertilization to get high yields," says Lang.

These tests show that fertilized plots without legumes produced 50 bushels of corn per acre. Legumes and no fertilization gave 60-bushel yields. But production jumped to over 100 bushels an acre when both legumes and fertilization were used.

Peas for Canning or Freezing . . .

(*From page* 16)

strong, the response to the higher levels of phosphorus and potash was not as marked. This is probably due to the fact that phosphorus fixation was much less severe in the less acid soils.

The average fertilizer recommendation for peas in New York State is 500 pounds of 10-10-10 fertilizer per acre for sandy and sandy-loam soils, and 600 pounds of 8-16-8 per acre for loam and silt-loam soils. Thus, peas should receive a minimum of 50 pounds of nitrogen (N) and potash (K_2O); while phosphate (P_2O_5) recommendations vary from 50 to 100 pounds per acre. Phosphorus applications are higher on the heavier soils because of phosphorus fixation.

4. ***Proper fertilizer application:*** Fertilizer should never be placed in contact with pea seed because of the severe injury which can result to germinating seedlings. Fertilizer placement experiments in New York, Michigan, Minnesota, and Washington indicate that the ideal placement of fertilizer for peas is in a band 1 to 2 inches to the side of the seed and approximately 1 to 1½ inches below the level of the seed. In these tests fertilizer was placed by special experimental drills. Since there are available no commercial drills which will place fertilizer properly at time of planting, the fertilizer should be drilled in deeply after fitting the field and before planting the peas. The fertilizer should not be disturbed by deep tillage operations after it has been drilled into the soil.

A summary of data obtained from 313 fields of peas in 1953 is given in Table III. From this Table it is very evident that growers who placed fertilizer in contact with the seed had yields which averaged considerably less than those of growers who applied the fertilizer in a separate operation. This difference was much more marked in the case of growers who used at least

TABLE III.—EFFECT OF RATE AND PLACEMENT OF FERTILIZER ON PEA YIELDS. 1953 SURVEY. 313 FIELDS.

Lbs. per acre N–P_2O_5–K_2O	Placement	
	Contact	Separate
50–50–50 or more.	1910 (6)*	2720 (39)
Less than 50–50–50	2260 (60)	2420 (208)
Average.....	2220 (66)	2470 (247)

* Number in parenthesis is number of fields in this category.

50 pounds each of N, P_2O_5, and K_2O per acre; while, as might be expected, the difference was not as marked among growers who used less than the recommended amounts of plant nutrients. In other words, the higher the rate of application, the more danger from injury when fertilizer is placed in contact with the seed.

5. ***Plant early:*** As mentioned previously, peas grow best in cool weather and hence should be planted early. Data proving this point were obtained in the 1953 survey (Table IV). It is evident from the data in this Table that as the season progressed, there was a marked decrease in yield of peas from later planting. Highest yields were obtained from peas which were planted in the first half of April, while the poorest yield came from one field which was planted in June.

6. ***Plant shallow:*** Shallow planting is very important, especially if the peas are planted early. At this time soil moisture is generally adequate and peas will germinate and emerge much more rapidly if planted in the warmer soil closest to the surface. Peas should not be planted more than one inch deep in order to insure rapid and uniform germination. The more rapidly the young seedlings emerge from the soil,

Fig. 7. Shelled peas from the viner are run through a cleaner. ***(Photo by Peter Hahn)***

TABLE IV.—EFFECT OF TIME OF PLANTING ON PEA YIELDS, 1953 SURVEY. 322 FIELDS.

Planted	Number of fields	Pounds per acre
April 1–15	88	2780
April 16–31	162	2340
May 1–15	56	1860
May 16–31	15	1680
June 1–15	1	1180

the less likelihood of infection from various damping-off organisms.

7. ***Roll or cultipack:*** The pea field should be rolled immediately after planting with a slat roller, or cultipacker. This operation settles the soil uniformly around the seed, thus facilitating uniform germination. Uniform germination is important because it will tend to insure even maturity of the crop. Since fields of peas are harvested when the most advanced peas are mature, any condition which causes lack of uniformity will result in reduced yields of those plants growing in areas of the field which have been delayed in maturity. In addition to uniform germination, rolling pushes surface stones down into the soil so that they do not interfere with the mower bar at harvest time.

8. ***Adequate plant population:*** As with most other crops, maximum yields of peas cannot be obtained unless there is an adequate number of plants to make maximum use of water and plant nutrients. Data obtained at Geneva in 1952 and 1953 (Table V) indicate quite definitely that, within the limits used, yields increased with increasing numbers of plants per acre. The highest yields of approximately 5,000 pounds per acre were obtained from spacing treatments which average 380,000 plants per acre, (Treatment A), while lowest yields came from a treatment with just half as many plants per acre, (Treatment D).

9. ***Weed control:*** Although peas are often plagued with many different kinds of weeds, chemicals which will control the great majority of annual broad-leaved and grassy species are available. If severe weed competition is present, it is obvious that the pea crop will suffer and cannot produce maximum yields. With the dinitro compounds which are available at the

TABLE V.—RESPONSE OF PERFECTION PEAS TO SPACING OR PLANT POPULATION TREATMENTS [1]

Spacing treatment	1952		1953	
	Plants per acre (Thousands)	Acre yield (Pounds)	Plants per acre (Thousands)	Acre yield (Pounds)
A. Solid—7″ drill rows	405	4860	361	5180
B. Solid—7″ drill rows	280	4530	274	4930
C. Plant 2 rows—skip 1 row	255	4150	238	4590
D. Plant 1 row—skip 1 row	196	3770	178	3840
LSD (19:1)	13	190	21	210

[1] Average of 12 replications each year.

present time, there is no excuse for any grower having a field of peas severely affected with weeds.

10. ***Insect control:*** Insects can be a factor in low yields of peas. The pea aphid carries various virus diseases and can transmit these viruses from one pea planting to another. The Entomologists and Plant Pathologists suggest that control of aphids might be a very practical method of reducing losses due to virus diseases in peas. Another insect which does not affect the yield of the crop but very definitely affects its marketability is the pea weevil. Good control of this insect is available with present insecticides.

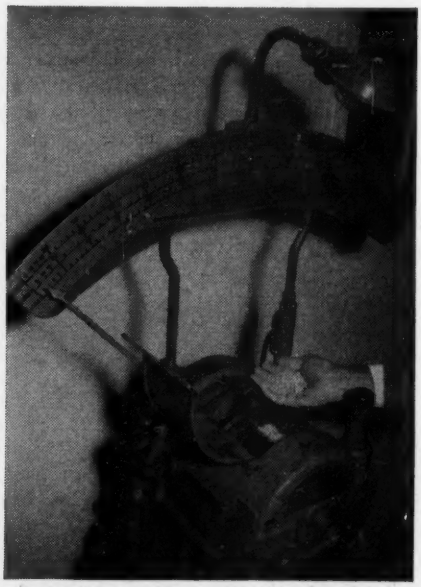

Fig. 8. The tenderometer—a machine which measures the tenderness of the cleaned shelled peas. Contracts are so graded that growers receive highest prices for peas of relatively low tenderometer value (88 to 98 for freezer varieties, and 95 to 105 for canning varieties). ***(Photo by Robert Wesselmann)***

11. ***Disease control:*** Peas are attacked by a large number of pathogens. In many cases, diseases such as root rot and some of the wilts severely reduce the yield of the crop. By judicious use of seed treatment, rotation, and other cultural and disease control practices, growers can keep incidence of most diseases at a minimum.

12. ***Irrigation:*** Lack of soil moisture as the peas approach maturity is very often a limiting factor in the growth of the crop. Experiments conducted at Geneva in 1952 and 1953 indicate that supplemental irrigation delays the maturity of the crop, while at the same

TABLE VI.—RESPONSE OF PERFECTION PEAS TO IRRIGATION. AVERAGE OF 1952 AND 1953.

	Acre Yield (Pounds)	Tender-ometer	Average delay in harvest
Not Irrigated	4,700	112	.....
Irrigated	5,340	114	½ day

time it increases the yield. It is evident from the data in Table VI that yields were increased by approximately 600 pounds per acre by using irrigation in 1952 and 1953.

Summary

If careful attention is given to the 12 points discussed above, it would be almost certain that a grower could expect an annual average of at least 3,000 pounds of fancy peas per acre in New York State, while average yields of 4,000 to 5,000 pounds would not seem unreasonable. With yields of this magnitude, processors and growers in this State would not have to worry about declining acreage and low returns from the pea enterprise, and they would be able to successfully compete with processors and growers in other areas of the country.

Relation of Fertilizer to Quality and Yield . . .

(*From page* 20)

TABLE IV.—THE EFFECT OF FIVE RATES OF POTASH ON THE VARIOUS INDICES, 1951-1953 (3-YEAR AVERAGE)

Potash lbs./acre*	Potassium in leaf (%)	Grade index (¢)	Yield /acre (lbs.)	Returns /acre ($)	Maturity index
0	1.73	41.9	1,750	733	59.6
60	1.83	42.5	1,939	824	58.1
100	1.82	43.8	1,942	850	60.0
140	1.99	43.9	1,989	874	57.9
180	2.01	43.4	2,017	876	56.9
L.S.D. (.05)	N.S.	1.2	166	34	2.7
(.01)	N.S.	1.6	226	47	N.S.

* With 20 lbs. N. and 100 lbs. P_2O_5 per acre.

Potash is fairly easily leached from sandy soils and needs to be constantly replenished. Potash imparts a resistance against drought and certain leaf diseases as well as improving leaf quality.

Magnesium Deficiency

Magnesium deficiency in flue-cured tobacco is rare because sufficient quantities of this element are added to the fertilizer. Magnesium deficiency is often called "sand drown" as it sometimes occurs on very sandy soils following heavy rains. Magnesium deficiency first appears as chlorosis, the leaf turning nearly white in the advanced stages. Some soils are quite deficient in magnesium which may be corrected by adding small amounts of magnesium sulphate. However, large quantities will depress the uptake of potassium.

Chlorine

Tobacco absorbs chlorine quite readily if present in the soil, but it is unessential to plant growth. Chlorine can be beneficial or detrimental to tobacco quality. Beneficial effects are obtained when the leaf contains between 1% and 2% chlorine. Chlorine increases the turgor, imparts a smoothness in the green leaf, and improves the hygroscopic properties and colour of the cured leaf. A chlorine content

TABLE V.—THE EFFECT OF CHLORINE IN 20-120-100 FERTILIZER ON THE CHLORINE CONTENT AND THE BURN OF THE CURED LEAF—1953

Treatment	Primings					Weighted average
	1	2	3	4	5	
	% Cl in leaf					
20 lbs. Cl/a (2%)	1.56	.88	.58	.45	.82	.75
40 lbs. Cl/a (4%)	2.78	1.54	1.02	.82	1.16	1.35
77 lbs. Cl/a (7.7%)	3.58	2.19	1.61	1.31	1.85	2.01
L.S.D. (.05)	.56	.47	.64	.24	.16	.21
(.01)	.85	.71	.96	.36	.25	.33
	Leaf burn in seconds per inch*					
20 lbs. Cl/a (2%)	455	498	528	584	573	528
40 lbs. Cl/a (4%)	540	498	526	607	609	542
77 lbs. Cl/a (7.7%)	644	645	552	648	688	612
L.S.D. (.05)	117	64	N.S.	N.S.	76	46
(.01)	177	97	N.S.	N.S.	114	70

* Burn is in seconds per inch of cigarette made from ground leaf.

above 1% lowers the fire-holding capacity. An excess of chlorine produces muddy, uneven colours in the cured leaf (2).

The chlorine applied in the fertilizer affects the burning quality of the leaf as shown in Table V. When all the potash was supplied as muriate of potash in a 2-12-10 tobacco fertilizer applied at 1,000 pounds per acre (77 pounds of chlorine), the time of burn in the first, second, and fifth primings was significantly delayed when compared with the regular 20 pounds of chlorine treatment. The chlorine content of the weighted leaf was significantly raised with each additional amount of chlorine in the fertilizer. The 40 pounds of chlorine per acre have about the same effect on the burn as the 20 pounds of chlorine in all but the first priming, even though the chlorine content was higher in the leaf. It would appear from these data that the maximum amount of chlorine in tobacco fertilizers could be raised slightly above 2%.

Quality, yield, returns per acre, and maturity data of flue-cured tobacco grown with various rates of the standard 2-12-10 tobacco fertilizer are presented in Table VI. Optimum quality, highest returns, and desirable maturity were obtained between the 1,000- and 1,200-pound treatments. The 1,800-pound treatment produced the poorest quality and the latest maturity tobacco. High rates of fertilizer are conducive to poor quality tobacco while low rates produce low yields.

TABLE VI.—THE EFFECT OF RATES OF FERTILIZER ON THE INDICES 1950-1953. (4-YEAR AVERAGE)

Rates 2–12–10 lbs./acre	Grade index (¢)	Yield /acre (lbs.)	Returns /acre ($)	Maturity index
800	43.6	1,820	793	59.8
1,000	44.1	1,872	826	60.0
1,200	43.8	1,899	831	58.2
1,400	43.3	1,888	818	57.5
1,800	41.1	1,932	795	53.5
L.S.D. (.05).	1.4	65	39	3.5
(.01).	2.0	87	N.S.	4.7

Summary

The plant-nutrient requirements of a 1,500-pound crop of flue-cured tobacco and the nutrients supplied by tobacco fertilizers are discussed. The effects of various levels of nitrogen, phosphorus, and potash on yield and quality of tobacco grown on Fox sand are reviewed. Heavy applications of nitrogen lower the quality of tobacco by producing a thin, trashy leaf. Phosphate fertilizers have small effect on yield or quality on light sandy soils that have been heavily fertilized in the past. High levels of potash are necessary to obtain high yields of good quality leaf. Even land that has been heavily fertilized with potash in the past will respond to potash applications. Magnesium deficiency is not apparent when magnesium is a constituent of the fertilizer.

The chlorine level for flue-cured tobacco fertilizers in Ontario has been held at a maximum level of 2% since 1951. Data indicate that a slightly higher level of chlorine in the fertilizer may not be detrimental to the burning quality of the leaf.

Comparison of various rates of the standard 2-12-10 tobacco fertilizer showed that 1,000 to 1,200 pounds per acre gave the most desirable results.

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Tradition

(*From page* 5)

are helping to make and mold traditions. Too often that's where we forget and fall into error. We think of tradition as something away back in the first chapters of our book of history —where the pages are yellow—and not in the present where the ink is scarcely dry.

Right in this very hour we make tradition, some of it of no universal worth although it may have local or family value. Not long ago a fellow told me that his daughters reminded him of some joyful and sustaining incidents of their childhood made possible by the devotion and thoughtful care on the part of their parents. The girls also look back with warm feelings toward the kind of generous and constructive community spirit upheld by their elders of the old neighborhood. "The moving finger writes, and having writ, it passes on."

I have another friend who likes to write small columns at regular intervals about the landmarks and traditions of the town as it was at the turn of the century. He speaks with reverence and tender regard for the once blithe spirits whose hopes and dreams fashioned the direction and the destiny of the city we know today. They, like us ordinary mortals of no wide renown, hued to the line and kept largely within the bounds of the sweetest traditions they treasured. What we have to "boast" about today in the modern parlance of progress would hardly be of consequence were it not mortared firmly to a sound and purposeful tradition.

Hence it is regretful to notice a badly worded statement hatched out in the historical offices supported by the state where I live. In making mention of the noteworthy items to be found in their archives, papers of famous authors and leaders and the like, we find this off-key writing:

"The Society's files boast the papers of most of the state's governors as well as the many records of persons *who are of little consequence individually.*" In

reply it might be said that no citizen of any decency and worth—humble though he may be—can ever be said to be of "little consequence individually." We still consider our ancestors to have been people of great importance as good and sturdy individuals of value to their own families and their home communities. They remain as important individually as anyone else, high or low. They are just as important to the welfare of the state and society in general as quite a number of our highly publicized and headline-hunting officials of the present day. The phrase might well have been instead: "Persons who were not widely known to the public." It's no disgrace to be somewhat obscure; it's darned unfair to be regarded as of small worth because of that obscurity.

BUT we can thank our stars for having had historians and public spirited citizens and leaders who honored traditions and kept faith with decent regard for others. So large is that scroll of noteworthy folks with such an outlook that just one example from the honor roll of our agricultural historians is sufficient.

Such a person was the late Dr. Rodney Howard True, native of Wisconsin. His parents were New Englanders and from this heritage came many of his inclinations. Primarily, True was a botanist. He served notably in that capacity at Wisconsin University, Harvard University, the USDA Bureau of Plant Industry, Pennsylvania University, and the Morris Arboretum. A focal point in his life was botanical and agricultural history, and it was in his office at the Department where the first steps were taken in 1919 to launch the Agricultural History Society. During this period he devoted much time to weed research and W. S. Dutton described him in the American Magazine for April 1929 as the "Sherlock Holmes of the Plant World."

The Plant Industry staff said that True functioned not as a boss so much as an elder brother, and to his students like a father. When decreased appropriations hit the Department, True resigned rather than reduce the employees with lower salaries. Meantime he had no other job in sight himself. Later, after serving for a period at Pennsylvania University, his colleagues characterized Dr. True thus: "Uninterested in his own material fortunes, generous to a fault, indifferent to considerations of position and fame, social or otherwise, Dr. True had his life being centered in the intellectual, artistic, and spiritual world. At heart an artist and a poet, he had love and discrimination of art, music, and literature. He was a stout defender of the truth and the right, irrespective of possible consequences to himself. What he perceived as injustices, social or otherwise, stirred him deeply."

We could easily join hands at this moment to give similar tribute to memories of many of the scientists and thinkers and strong workers we have known—men who maintained certain vibrant and compelling inner values by which to measure and weigh their plans and actions. You might ask indeed where those inner forces came from, what they were, and what made them so dominant. I doubt if education alone did it—in fact, too much of some kinds of education can't produce it. Mainly it stemmed from appreciation—glad remembrance of the best of the past, and a stout resolve to perpetuate it and treasure it and hand it on with renewed lustre and truth.

WHEN we speak feelingly and proudly about the "American tradition," it really means several lines or branches of tradition. I can easily think of the less desirable forms it has taken and may take in the future, but shining away above all the battered and misshapen traditions we are often ashamed of in the presence of eager foreigners are several of the noblest that have ever animated and directed the destiny of mankind.

The ancient family motto "Never

put off 'til tomorrow the things you can do today" plus that other one "the Lord helps those who help themselves" have begotten a pretty sound trait in American life. When things go wrong and some mechanical or other adjustment is urgent, a majority of our technical service folks can render prompt and satisfactory assistance. It's the trade-mark of our machine and power age to do it quick and do it right and make it run again. That's where we shine all right in a world too full of heedless and lazy and incompetent breadwinners.

"Make the best better" slogans adopted by 4-H clubbers merely reflect the age-old tradition of America to advance and improve and excel. But right in the midst of all these vivid and impressive doings which make over our lives for us daily, we have another fine tradition that balances it.

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Some say that our tradition of reverence and respect is vanishing in the welter of material success. Even in the face of too many records of hoodlum kids and youthful malefactors, it is not too difficult to locate continuing signs of spiritual composure and abiding faith in the things that are true, honest, just, lovely, pure, and of good repute. As St. Paul remarks: "If there be any virtue, if there be any praise, think on these things."

So I guess we wouldn't amount to much or make much progress without leaning more or less on traditions. But they can't be the weak and wobbly, narrow ones. They've got to be the broad, sound, and time-tried bridges that have carried our people a long way toward Beulah Land.

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A vivacious young student from Colo. A & M College visiting in Boston shocked her Eastern-reared beau by drawing on her gloves as they started down the street on their first date.

"Where I come from," chided the young man, "people would as soon see a woman put on her stockings in public as her gloves."

"Where I come from," retorted the young lady, "they'd rather."

* * *

"I wasn't born in a log cabin," declared the candidate, "but my folks moved into one as soon as they could afford it."

* * *

A small girl entertaining a visitor while her mother was telephoning, asked politely, "How is your little girl?"

"I'm sorry to say," replied the visitor, "that I haven't a little girl."

"How is your little boy, then?"

"I haven't a little boy, either."

The child looked suspicious. "Then what are yours?"

* * *

A tourist spending the night in a small Vermont town joined several men sitting on the porch of the general store. They were a taciturn bunch and, after several vain attempts to start a conversation, he finally asked, "Is there a law against talking in this town?"

"No law against it," answered one of the men, "but there's an understanding no one's to speak unless he's sure he can improve on silence."

"In his will your late employer has named you as his beneficiary," said the lawyer.

"It wasn't me, sir," said the girl anxiously. "I know he had one, but it wasn't me, honestly!"

* * *

The seventh-grader was going to his first school dance. With a rented tuxedo and a great display of sophistication, he was strutting across the campus when he met a Junior. "Yuh gonna take a girl?" asked the Junior. "Naw," answered the seventh-grader, "I think I'll just go stud."

* * *

A married man knows there are three sides to every question—his side, his wife's side, and to hell with it.

* * *

Two friends went duck shooting one cold morning. One took along a thermos bottle full of coffee while the other had a bottle of Old Typesetter.

Both imbibed freely of their chosen beverages through the early hours and finally a lone duck appeared overhead. The coffee drinker raised his gun first, took aim and fired. The duck kept on going. His friend then pointed his gun at the duck and brought it down with the first shot.

"That's pretty good shooting," said the first.

"Nothin' to it," shrugged the other. "When a flock like that comes over, you're bound to hit one of them."

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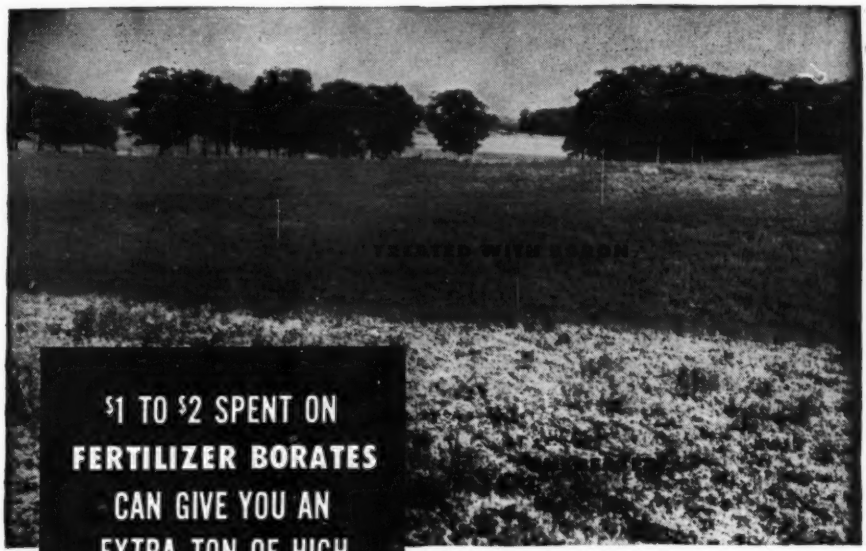

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